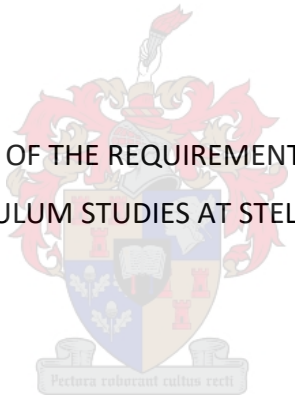
BIOLOGY TEACHERS' VIEWS AND ATTITUDES TOWARDS PRACTICAL WORK IN THE KHOMAS REGION, NAMIBIA

BY

ALINA NAMBASHU SHIKONGO



THESIS PRESENTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION IN CURRICULUM STUDIES AT STELLENBOSCH UNIVERSITY

SUPERVISED BY: PROF LESLEY LE GRANGE

DEPARTMENT OF CURRICULUM STUDIES

DECEMBER 2020

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights, and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Alina Nambashu Shikongo

……

Date: December 2020

DEDICATION

I dedicate my dissertation to my family. A special feeling of gratitude goes out to my loving mother Hilja Shifugula. I would not be here today if it was not for her sacrifices, patience, love and support. In the same breath I extend it to my beloved father Efraim Tsheehamandje Shikongo who always gave me a word of encouragement and reminded me to pray through it all. I extend my dedication for the unending care, support and love from my siblings, and single out my dedication to my late brother, Helmut Iyambo Magano Shikongo who did not live long enough to witness a special moment such as this in my life.

ABSTRACT

Biology examination reports confirm that the performance of learners is moderately low when answering the Biology Paper 3 (the Practical examination paper). No reasons have been provided for this outcome. However, an interest is developing in understanding why learners perform poorly in this specific paper, when compared to their performance in Papers 1 and 2. Practical work as a section of the Science educational curriculum is considered to be a methodology which engages learners in practical exercises. It aims to assist learners to reach the target of an adequately detailed scientific investigation as required by the curriculum, since this forms the central focus of science. The focus of this study was on teachers' attitudes and views of practical work because these attributes impact on learners' performance in practical work.

This study adopted a quantitative design, which included a questionnaire that accommodated a few short qualitative open-ended questions. The instrument contained items which had to be thoroughly studied and examined. The population consisted of the Biology secondary school teachers in the Khomas region of Namibia who were teaching Grades 9 to 11 levels. The study targeted at least two to three teachers in each school offering Biology, which were visited by the researcher in the Khomas region in 2019.

This study aimed at assessing the views and attitudes of Biology teachers towards practical work in the Khomas region of Namibia. The participants in this study showed positive attitudes towards practical work and there were no significant differences among the mean rankings of the different items on the instrument that measured teachers' views of the aims of practical work. On the whole there were no significant differences between male and female teachers' attitudes and views towards practical work.

Key words: Practical work / activities, Assessment, Examination, Practical equipment, Namibia, Scientific enquiry, Instructional strategies

OPSOMMING

Die Biologie-eksamenverslae toon dat die prestasie van leerders in vraestel 3 (die praktiese eksamenvraestel) matig tot laag is. Daar word geen redes t.o.v hierdie uitkoms aangetoon nie. Gevolglik is daar ‘n belangstelling om te wete te kom waarom leerders 'n lae prestasie in hierdie spesifieke vraestel, in vergelyking met vraestelle 1 en 2, behaal. Die praktiese werk, as 'n deel van die wetenskaplike opvoedkundige kurrikulum, word beskou as 'n metode om leerders by die praktiese beoefening van wetenskap te betrek. Die bedoeling is om leerders te help om die mikpunt van ‘n voldoende gedetaileerde wetenskaplike ondersoek te bereik, soos deur die kurrikum vereis word; aangesien dit die kern van wetenskapsbeoefening vorm.

Die studie volg ‘n kwantitatiewe ontwerp, wat gebruik maak van 'n vraelys met enkele kort kwalitatiewe vrae ook ingesluit. Die instrument bevat items wat egter deeglik bestudeer en ondersoek moes word met die oog op dataverkryging. Die populasie bestaan uit Biologie-onderwysers wat Graad 9 tot 11 in die hoërskole in die betrokke in die Khomas streek van Namibia. Die studie het in 2019 ten minste twee tot drie Biologie-onderwysers per skool in die Khomas-streek betrek. Hierdie studie se doel is om die sienings en houdings van Biologie-onderwysers ten opsigte van praktiese werk in die Khomas-streek van Namibië te beoordeel..

Die deelnemers van die studie het die insluiting van die praktiese doelwitte wat gelys is, en die items wat gegenereer is, omarm, en volgens hulle vlakke van belangrikheid gerangskik. Die doel is om die deelnemers se houding t.o.v die praktiese werk te toets. Die studie het bevind dat onderwysers oor die algemeen positiewe houdings teen oor praktiese werk toon. Geen beduidende verskille was bevind in onderwysers se prioritisering van verskillende items op die instrument wat hul sienings teenoor die doelstelling van praktiese werk gemeet het nie. Daar was geen beduidende verskille manlike en vroulike onderwysers se houdings en sienings oor praktiese werk nie.

ACKNOWLEDGEMENTS

Firstly, I would like to thank the all-powerful God, for His unfailing love. His encompassing love has allowed me this opportunity to enrol for my Master's degree. He has been with me through it all, even when the going was intense. I praise Him for the wonders He has brought about in my life.

Secondly, I would like to thank my supervisor, Prof Lesley Le Grange, for directing me so well during my studies. Prof, I cannot thank you sufficiently, you have made my study simpler than I thought it would be, even when you had so much on your plate. You have requested quality and insightful work and pushed me to my best of ability, and this is why I am here today. I find it very important to acknowledge that I have been blessed to have worked with an esteemed scholar and academic like Prof Le Grange. I proceed to pray for you, so that you will continue to do this for those coming behind me.

Furthermore, I would like to thank the following for their great direct and indirect support:

- Prof Kidd, who worked tirelessly to help me with data analysis. Prof you have been so kind and helpful to me.

- Mr John Endjala, thank you for advising and pushing me to enrol for a Master's degree. Your financial support is highly appreciated.

- Dr Sirkka Tshiningayamwe, I acknowledge you for paving the way and for showing me that it goes beyond a teaching degree.

- Robert Otumuna Ambunda, you have been there from the very beginning till the end. I cannot stress enough how much of a blessing you are to me. Thank you for the unending moral support, for pushing me, for always cheering up on me, for opening my eyes to only see the greatest and best and for making Stellenbosch feel like home. You have greatly contributed to my study in ways I cannot even explain. God bless you.

- Martin Atshipara, I do not have sufficient words to thank you for just being the person you have been to me throughout my studies and more importantly in my life. You are heaven- sent. God bless you and continue to do this for others.

- My Inspiration, Rev. Kleopas Nakale, for your everyday advice, prayers, jokes and support from way back and throughout my studies. Thank you so much.

- Dear Tate Amupolo, your genuine love and unwavering support offered to me for as long as I remember are highly appreciated.

- The school principals and school management teams that kindly granted me permission to conduct my study at their respective schools. At the same time, I would like to thank all the Biology teachers who made time to take part in this study, given their busy schedules; without them, this study could not have materialised.

1. To the Ministry of Education, Arts and Culture;
2. Khomas Regional Council Directorate of Educational, Arts and Culture; for the permission granted to carry out the study at the schools of the region.

I would like to further acknowledge my friends and family for their support. They kept me going, pushing me in all sorts of ways.

Lastly, I would like to thank my lovely mother for her genuine love, care, support and sacrifices. I wouldn't be here today if it had not been for your effort and sweet love. My dear father, you have shown me love like no other, for your prayers and for always believing in me. In the same vein my gratitude goes out to my siblings, Gwatshiimi, Nelago, Ndeyamomuwo, Otaliya as well as Tsheehamandje Junior for being good to me; your moral support and motivation are highly appreciated.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

MoE : Ministry of Education, Arts and Culture

IGCSE : International General Certificate Secondary Education

HIGSE : Higher International General Certificate Secondary Education

INSTANT : In-service Training and Assistance for Namibian Teachers

ESM : Effective School Management

SAPA : Science a Process Approach

1 Introduction

In Colonial times, practical work presented numerous problems for Namibian schools. This was because of a lack of qualified Science teachers who had the requisite skills to carry out practical work in classrooms. As a result, learners found practical work challenging and uninteresting, since they scarcely grasped the concept of it. During apartheid, black children in Namibia were deprived of quality education and did not receive quality teaching because of their skin colour. However, they were permitted to sit, listen, watch and memorise the results of the practical work demonstrated to them by the teacher during practical activities (Kandjeo-Marenga, 2008).

During the Colonial Science curriculum implementation, practical work was not considered a priority. Due to this situation, Science examinations excluded practical work and required the recall of scientific facts rather than an examination of whether the candidate experienced Science as a holistic human endeavour. This in turn required an examination of procedural abilities and states of mind. This again brought about a situation where black learners lacked the necessary preparation for future Science-related employment and also a failure to create fundamental mindfulness around the values of Science in their everyday lives. Angula (1993) averred that white learners had good exposure to practical work.

This chapter briefly outlines the study. Section One will present a brief background to the study, focusing essentially on the importance of practical work as well as on the significance of teachers' attitudes and their views towards practical work. In the second section, the chapter presents the problem statement and the research questions guiding this study. An overview of the research methodology, data gathering, validity of the study and the ethical procedures used in the study is provided. Lastly, the chapter gives an overview of how the rest of the thesis will be organised.

1.1 Study background

Namibia gained independence in 1990 and thereafter, the Ministry of Education Arts and Culture (MoE) presented a new education system which was planned to investigate the

imbalance and disparity within the education system (Ministry of Education and Culture, 1993). The distinctive objective of this system was to prepare learners with the information and abilities that would empower them to further their studies locally and universally after having successfully matriculated. As soon as Namibia gained independence, the MoE established a new curriculum bringing with it an inclusive "Education for All" philosophy. This was aimed at leaving behind the system that had existed prior to independence: an education system which advantaged white children and excluded black children due to the South African laws of apartheid (Ministry of Education and Culture, 1993). The reformed curriculum mandated a compulsory Mathematics and Science curriculum from Grades 1 to 10. The curriculum also proposed a learner-centred teaching approach as well as the writing of practical examinations (Paper 3) at the end of Grade 12 (Ministry of Education, Arts and Culture, 2018).

At present, the assessment objectives of Biology in Namibia are summarised in the syllabus (Ministry of Education and Culture, 1993, p.35) as follows:

i. Objective A: Knowledge with understanding.
ii. Objective B: Handling information, application and solving problems.
iii. Objective C: Practical (experimental and investigative) skills and ability.

According to the Ministry, Objective (a) focuses on:

> … subject matter content, scientific phenomena, facts, laws, definitions, concepts, theories scientific vocabulary, terminology, conventions (including symbols, quantities and units); scientific instruments and apparatus, including techniques of operation and aspects of safety; scientific and technological applications with their social, economic and environmental implications (Ministry of Education, Arts and Culture, 2018, p.35).

According to the Ministry, Objective (b) reads as follows:

> … locate, select, organise and present information from a variety of sources; translate information from one form to another; manipulate numerical and other data; use information to identify patterns, report trends and draw inferences; present reasoned explanations of phenomena, patterns and relationships; make predictions and propose

> hypotheses; solve problems including some of a qualitative nature as they relate to everyday life (Ministry of Education, Arts and Culture, 2018, p.35).

According to the Ministry, Objective (c) reads as follows:

> … demonstrate knowledge of how to use apparatus and materials safely (including following a sequence of instructions where appropriate); plan experiments and investigations (including how to record accurate estimates, observations and measurements accurately and make deductions from simple tests); handle and process experimental observations and data (including dealing with anomalous or inconsistent results) (Ministry of Education, Arts and Culture, 2018, p.35).

This study will focus mainly on Objectives (b) and (c), as they focus specifically on practical work that requires learners to know how to handle information, how to apply it and how to solve problems. It also aims to help learners to achieve "the experimental and investigative skills thoroughly" (Ministry of Education, Arts and Culture, 2018, p.36).

Ministry of Education, Arts and Culture (2018) states that all learners in Namibia enrolling in Science for Grades 11 and 12 are required to write the three examination papers: Paper 1 contains multiple-choice questions; Paper 2 contains structured questions and Paper 3 contains questions based on practical work. These papers are written at the end of the academic year. Nghipandulwa, (2012) emphasises that theoretical teaching dominates practical work in Namibia, given that most of the content is theory-based, even though the Biology syllabus requires hands-on practical work. Namibian schools are challenged by a lack of practical equipment which reduces the ability of learners to do practical work at secondary school level (Nghipandulwa, 2012).

1.2 Description of the problem

According to the Ministry of Education, Examiner's report (2016;2017), the Biology Paper 3 examiners' report shows that the performance of the majority of candidates continues to be poor. The report indicates that excellent marks were scored by a few candidates while most

candidates scored low marks. This report further points out that candidates are given sufficient time to complete the practical examination, therefore time allocation is not a contributing factor to the poor performance of learners in this paper. Jones, Reed and Weyerns (2016) state that in a subject such as Biology, doing practical work is important, considering that practical work grounds a learner's understanding of the theory when it is applied to real life examples of specimens, organisms, habitats, equipment, processes and reactions. Practical work permits learners to understand scientific concepts better through the development of scientific processes required to learn Science in the laboratory (and elsewhere) during practical sessions.

However, previous studies have found that teachers' poor attitudes towards teaching Science have lowered learners' academic performance (Jones , Reed and Weyerns 2016). Therefore, in this study, the researcher will seek to assess secondary teachers' attitudes and views towards practical work in Biology. The main research question for this study is:

What are Biology teachers' views and attitudes towards practical work in the Khomas Region of Namibia?

i) Is there a difference between male and female biology teachers' attitudes and views towards practical work?

ii) Is there a difference between experienced and less experienced biology teachers' views and attitudes towards practical work?

1.3 Hypotheses

The study tested the following four hypotheses:

i) There is no significant difference between male and female biology teachers' views towards practical work.

ii) There is no significant difference between experienced and less experienced biology teachers' views towards practical work.

iii) There is no significant difference between male and female biology teachers' attitudes towards practical work.

iv) There is no significant difference between experienced and less experienced biology teachers' attitudes towards practical work.

These hypotheses tested whether there are significant differences between samples with regard to their mean scores of individual items on the rank-order scale and their individual attitudes on the importance of practical work on the 5-point Likert scale. These hypotheses were tested on female versus male as well as experienced versus less experienced Grades 9 and 11 biology teachers of the Khomas region, Namibia.

1.4 Research Methodology

The general aim of this study is to assess the attitudes and views of secondary school Biology teachers towards practical work in the Khomas region of Namibia. In any study, in order to obtain a better understanding of the phenomena being investigated, a researcher must choose a suitable research strategy. To achieve the above-mentioned aim and to answer the research question, this study uses the quantitative method as a means to produce data. A survey research design was employed in this study. Robert (1989) states that this method is said to be one of the easiest methods of data collection, as respondents experience less inconvenience than in other research studies. According to Leen (1989), respondents feel much more comfortable with the publication of the study results.

This survey study employs a questionnaire that is divided into two parts: an attitudinal scale and a rank-order scale of the teachers' views with three qualitative questions at the end. Firstly, the attitudinal scale that was used is a Likert scale. A Likert scale is used to signify people's attitudes towards certain situations. This scale was first developed by Likert in 1932 to measure people's racial attitudes in the USA. Likert (1967) alluded to the fact that when researchers are collecting data and structuring statements, they must keep certain criteria in mind for the survey questionnaire. According to Likert (1967) the nature of statements used in the questionnaire should consider and accommodate persons of different backgrounds, as they will have differing views and attitudes. In this survey research, the researcher shall measure the attitudes of Biology teachers in the Khomas region of Namibia which are measured using a 5-

point Likert scale. The statements are set to measure the attitudes of teachers towards practical work. The respondents were expected to indicate whether they 1= *strongly disagree*, 2 = *disagree,* 3 = *remain neutral*, 4 = *agree*, and 5 = *strongly agree*. This helps to determine the positivity or negativity of the teachers' attitudes towards Biology practical work.

Secondly, a rank-order scale is used to measure teachers' views of the aims of practical work. A rank-order scale allows respondents to modify and rank varying alternatives in a particular order. The respondents were asked to rank ten (10) given items in their order of priority. The items relate to the views teachers have of the aims/purposes of practical work for Biology as a subject for Grades 9 and 11. Thirdly, on the same questionnaire, an open-ended question was included at the end, in which respondents were asked why they had ranked the top 3 aims as most important. The purpose of this question was to clarify the motivation behind respondents' decision to rank the top three items.

1.5 Scope of the research

This study focuses on Biology teachers' views of the aims/purposes of practical work and their attitudes towards practical work. The teachers who took part in this study were from Science departments of secondary schools in the Khomas region, Namibia.

1.6 Ethical considerations

It is a well-known fact that ethical issues arise in numerous circumstances of life. Subsequently, moral issues are anticipated to emerge during this study. According to Leen (1989), Ethics is that branch of information that deals with moral values. It is for this reason that a letter requesting permission to conduct the research in the schools of the Khomas region was written to the Ministry of Education, Arts and Culture. Thereafter, an application was submitted to the Research Ethics committee (Human Research) at the University of Stellenbosch for ethical clearance. The participants were requested to sign a letter of consent to ensure that they agreed and only after these had been received, was the questionnaire distributed. The information provided by the respondents was treated with confidentiality and anonymity. Respondents were permitted to withdraw from the study at any point if they wished to do so.

1.7 Significance of the study

To understand the teachers' concerns, and to assist policy makers to help teachers with the challenges they face, the researcher was of the opinion that investigating the views and attitudes of Biology teachers towards practical work in the Khomas region of Namibia might be significant. In addition, it was the researcher's intention that the findings of the study would be useful to teacher advisers, curriculum developers and subject policy makers of the Ministry of Education, Arts & Culture, to develop interventions which would support Biology teachers to understand the value of practical work. This in turn would improve their views and attitudes. The researcher hoped that this would potentially have an influence on improving the practical work in Biology in the Khomas region of Namibian schools. This study's findings promise to supply valuable data for teacher educators in their attempt to prepare student teachers with the information and skills they require in relation to practical work. Such interventions as part of professional development programmes promise to contribute to improving the quality of the teaching and learning of Biology, and as a consequence improve practical performance in the subject.

1.8 Operational definition of key terms

Practical work- Millar (2011) describes practical work as any type of Science teaching and learning activity in which students work either individually or in small groups where they are involved in manipulating and/or observing real objects and materials (e.g. determining which of selected objects are magnetic; carrying out and observing flame tests). This is opposed to virtual objects and materials such as those obtained from a DVD, a computer simulation, or even from a text-based account (Millar, 2011). Secondly, Millar (2011) defined practical work as a learning experience in which students interact with materials or with secondary sources of data to observe and understand the natural world. Students will understand the Science concept by conducting experiments in the laboratory (Lee and Sulaiman, 2018).

Attitude - Generally, an attitude is understood to mean the conduct an individual adopts toward other individuals, things, occurrences, or happenings. In Science instruction, attitude is

an imperative contributing factor affecting the execution of Science learners. According to Chawla, Jain and Mahajan (2013) an attitude is a way of looking at things. An attitude may be better defined as a predisposition to respond in a favourable or unfavourable manner with respect to a given attitude object (Oskamp and Schultz, 2005). Attitudes can be positive, neutral or negative. According to Chawla, Jain and Mahajan (2013), an attitude is a way of looking at things positively or negatively. Based on studies by Yara (2009), the attitude which a teacher portrays in delivering a lesson (which also includes the teaching strategy used) has a great influence on learners' attitudes towards the lesson content. He confirms that teachers with a positive attitude towards a subject arouse complimentary attitudes in their learners. According to Abudu and Gbadamosi (2014) learners' accomplishments are strongly influenced by the attitude with which Science subjects are conveyed.

Views - In this research, a view is understood to mean the feelings, thoughts and opinions or ideas of an individual perceived and acknowledged at a particular moment in time and context (Jiao, 2005). Aikenhead and Ryan (1992) found that knowledge of participants' views can be investigated and gained by reading respondents' replies to given items, normally from a Likert scale format. Their responses are analysed in order for their viewpoints to be determined. He alluded to the fact that respondents will either have consistent responses or not. The authors stated that when respondents agree to the items, this does not necessarily disclose their true meaning, since in some cases, language may be a barrier.

1.9 Limitations

In this study, the gathering qualitative data was limited to a sample of Biology Grade 9 and 11 teachers from secondary schools in the Khomas region, Namibia. Therefore, the self-reported information obtained from questionnaires may be inaccurate or incomplete. The administration of the structured questions may have created an unnatural situation that alienated the respondents. Some respondents struggled to understand the questions leading to uncertain responses.

1.10 Summary of chapter

This chapter briefly introduced the readers to the subject of the study, and why it was researched. The chapter particularly provides insights into the motivation and background of the study, the significance of the study, the research problem, the research question, the research methodology, and ethical considerations.

1.11 Structure of the thesis

Chapter one: In this chapter, the reader is briefly introduced to the subject of the study and why it was conducted. Further, the researcher particularly provides an insight into the motivation and background of the study, the significance of the study, the research problem, the research question, the research methodology and ethical considerations.

Chapter two: In this chapter, literature dealing with the inter-relationship between teachers' attitudes towards practical work and their views on the one hand, and the performance of learners on the other, is reviewed, starting from a global perspective and further narrowing it down to the Namibian context. The history of practical work, the importance of practical work, challenges faced during practical demonstrations and a few more aspects of practical work are discussed in this chapter. A snapshot of the educational situation prevailing in Namibia is provided, which traces the historical, political and social developments that have taken place since Namibia gained its independence and which in turn have led to the present curriculum.

Chapter three: In this chapter, the research methodology, the procedures and the strategies used in the study are discussed. Methods of gathering data, analytical strategies and methods of establishing validity and ethical procedures that will be employed to accomplish the aim of this research are discussed in this chapter.

Chapter four: This chapter presents an analysis, description and interpretation of the results of the study.

Chapter five: In this chapter, the findings of the preceding chapters are outlined and conclusions are offered. The main findings are discussed and recommendations are made based on the analysis which will emerge from the research presented.

2 Literature review

2.1 Introduction

In academic studies, published work should be reviewed in order to analyse the body of available literature thoroughly. It is for that reason that this chapter: a review of literature dealing with the views and attitudes of Biology teachers towards practical work, is carried out, in order to provide justification for the study and to assist the researcher in formulating appropriate recommendations.

DaCosta (2007) defined a *literature review* as a systematic gathering of information related to a particular topic. He added that working systematically helps a researcher recover a wide range of resources suitable to the topic. He outlined the following reasons why a literature review is conducted: sustaining a level of current awareness in a certain field helps a researcher to stimulate fresh ideas; it provides answers to particular study questions; it allows researchers to stay updated in their study areas and it assures researchers that they are producing quality and original work.

According to Winchester and Salji (2016) a researcher conducts a review of existing studies by critically conducting an in-depth analysis of the body of relevant knowledge in order to demonstrate how one understands the work of others. Winchester and Salji (2016) stress the importance of reviewing literature in any study, because it provides all the information needed, giving a balanced view of the content that comes with the information gathered. The review of previous literature similar to the current study allows the researcher to review methods used by other researchers. This helps the researcher to choose the appropriate study methods for investigating the phenomenon. Based on this insight, the present literature review will focus on those aspects that contribute to the attitudes and views encountered by teachers during their practical sessions.

This chapter describes how practical work was established, its importance as part of the Namibian Biology syllabus and how it impacts the learning of Biology as a subject at secondary school level. Further literature relevant to the two major constructs views and attitudes in

Science education is reviewed, as well as relevant research on these topics which has been conducted both internationally and locally.

2.2 Namibian education: A background

2.2.1 Education pre-independence

Namibia is a country located on the south-western coast of Africa, and was therefore formerly known as South-West Africa. Namibia was first colonised in 1884 by Germany. After the First World War ended in 1918, Namibia was placed under South African control. It gained political independence from South Africa on 21 March 1990. According to Wilfred (2015), Namibian education underwent three phases before independence and the fourth phase followed after independence was gained. The three phases are as follows:

1. Pre-Bantu education (before 1962);
2. Bantu education (between 1962-1976);
3. Post-Bantu education (from 1977 onwards).

Namibia had a general pattern of political and socio-financial changes that complemented the three phases of education. According to Amukugo (1993), Bantu education merely served to benefit apartheid proponents. People of colour did not benefit from Bantu education, since it denied them the right to equal opportunities and resources in education. He contends that this education system stimulated racial myths and stereotypes within school subjects' reading materials and the general curriculum, adding that the education system had been designed to supply black people with only sufficient essential literacy and numeracy aptitudes to prepare them for clerical occupations in Colonial times. Before Namibia gained independence, its African people had learned in both formal and informal ways. The younger generation learned through informal means, by observing cultural norms and skills exhibited within their communities. This young generation was provided with a platform to learn a great deal from the elders, and this gave them a glimpse of how to work and interact with other people (Wilfred, 2015).

According to Dahlstrom (1995), Namibian traditional societies were first given a missionary education which was further entrenched during the German Colonial rule. This rule denied black children appropriate education as they were controlled by Germans in the missionary societies, while white children were given compulsory education. In addition to this, Dahlstrom (1995) argues that:

> The system of unequal funding for black and white schools was another structural characteristic introduced by the Germans that in principle remained in Namibia through the apartheid era up until Independence in 1990 and beyond. The preparing of the ground for the apartheid policy was furthered through the expressed preference for the boer system by the German administration (p.149).

Due to the apartheid German rule, Dahlstrom (1995) noted that children did not receive equal education, which resulted from an unfair allocation of education funding between blacks and whites. The schooling of a Namibian child was merely determined by the South African apartheid philosophy. For this reason, there was a clear unmistakable distinction between a black and a white child's schooling. White children gained much better skills, since they received a much better education than did black children. White children were advantaged to have had trained teachers to educate them on the distinctive Science handle aptitudes. In contrast, black children's schools were not equipped with laboratory facilities and they were frequently instructed by unfit teachers (Dahlstrom, 1995). This situation remained prevalent until 1990 when Namibia gained independence

Katjavivi (2016), a Namibian politician who is the Speaker of the National Assembly of Namibia and the Founding Vice Chancellor of the University of Namibia, expressed the following in a speech that he addressed at the Commonwealth Parliamentary Association in London in 2016:

> Before Namibia's independence, the country's education system was designed to reinforce the Apartheid system rather than provide the necessary human resource base to promote equitable social and economic development. It was fragmented along racial and ethnic lines, in what was termed the Bantu Education system, which was also being enforced in black communities in South Africa, with vast disparities in both the

> allocation of resources and the quality of education offered and it had a great impact on the quality of education in the country (p.8).

According to Kandjeo-Marenga (2008), during Colonial times, some Namibian schools had science laboratories, while other schools did not offer Science subjects. Due to a lack of well-equipped laboratories, teachers had difficulty in carrying out practical work, because resources were not sufficient for usage. They were forced to replace physical practical activities with verbal demonstrations, in order to keep the education running. Kandjeo-Marenga (2008) added that learners were pressured to memorize the demonstrations. Furthermore, learners were taught through teacher-centred methods, which meant that teachers transferred their subject knowledge to learners through verbal means. Due to the Colonial system, learners in black schools could not receive good quality Science teaching because most Namibian Science teachers had not been effectively trained. Quality education is based on well-prepared and trained teachers, in order to meet learners' educational needs, interests and abilities; but this was not accomplished during Colonial times (Kandjeo-Marenga, 2008).

2.2.2 Post-independence (1990) education

According to Mutorwa (2002), the most remarkable advance within the education system made by Namibia was the diminishing of the disparity in instruction. After Namibia gained its freedom, it broke away from the apartheid educational structure and a unified structure of education was set up by the government of Namibia with the aim of moving the education forward for each Namibian. The education system aimed to educate all Namibian learners equally, therefore it was called "Education for All". It is currently the right of every Namibian child to be educated. Article 20 of the Namibian Constitution states the following:

> All persons shall have the right to education. Primary education shall be compulsory and the State shall provide reasonable facilities to render effective this right for every resident within Namibia, by establishing and maintaining State schools at which primary education will be provided free of charge. Children shall not be allowed to

leave school until they have completed their primary education or have attained the age of sixteen (16) years, whichever is the sooner, save in so far as this may be authorised by an Act of Parliament on grounds of health or other considerations pertaining to the public interest. All persons shall have the right, at their own expense, to establish and to maintain private schools, or colleges or other institutions of tertiary education provided that:

i. Such schools, colleges or institutions of tertiary education are registered with a Government department in accordance with any law authorising and regulating such registration;
ii. The standards maintained by such schools, colleges or institutions of tertiary education are not inferior to the standards maintained in comparable schools, colleges or institutions of tertiary education funded by the State;
iii. No restrictions of whatever nature are imposed with respect to the admission of pupils based on race, colour or creed;
iv. No restrictions of whatever nature are imposed with respect to the recruitment of staff based on race or colour (Article 20 of the Namibian Constitution).

The Ministry endeavoured to include vulnerable and street children. The “Education for All” reform further aimed to achieve a 100% enrolment for Namibian schooling by the year 2030 (Mutorwa, 2002). Due to the poverty faced in Namibia, the MoE established free education for primary education, stating that it is important for every child to have a primary foundation. Ninnes (2011) notes that the prerequisites and the particular geographic, social and political settings of Namibia have introduced instructive laws and approaches to bolster the structure of educating every Namibian child, in order to advance differentiated, competent and significantly beneficial human resources and to construct a knowledge-based society.

During apartheid, Afrikaans was the medium of instruction, therefore, learners were taught in Afrikaans. The post-Colonial government replaced Afrikaans with English which became the medium of instruction in schools across the country (Ninnes, 2011). Moreover, the teaching-learning approach aimed mainly at benefiting learners, in the sense that they were actively

involved in the learning process. In other words, a platform was provided for learners to interact with the teacher, thereby establishing a learner-centred approach. Aloovi (2016) argues that at this point in time, Namibian schools were staffed by inadequate and under-qualified teachers. This situation required a critical rearrangement, which resulted in the altering of teaching methodologies.

The learner-centred approach was established and released in 1998 for Grades 1-12 learners across the country (Katjavivi, 2016). Mutorwa (2002) stated that in addition to a learner-centred approach, continuous assessment and the semi-automatic promotion of learners was introduced. As the National Institute for Education (NIED) continued to change the curriculum over the years, new teaching materials were constantly being developed. According to the Ministry of Education and Culture (1993), learners are required to participate actively in course work activities based on the requirements of the syllabus, for assessment purposes.

A new curriculum was established in 1991 and was divided into four phases: lower primary (Grades 0-4); upper primary (Grades 5-7); junior secondary (Grades 8-10) and senior secondary (Grades 11-12). This curriculum by the Ministry required every child to complete the primary education programme (Grades 1-10) and the senior secondary (Grades 11-12). The following goals for schooling were outlined by the MoE:

i. Improved access to schooling;
ii. Improved learning outcomes and learning with understanding;
iii. Improved curricula and examination systems;
iv. An equitable distribution of educational resources and services and reform of secondary education (Ministry of Education and Culture, 1993).

The implemented curriculum came with free education for Grades 1-7 learners, only requiring parents to provide school stationery for learners. Primary education prepares learners for a junior secondary education, in order for them to achieve a Grade 10 certificate. This in turn grants them access to the senior secondary phase where they are expected to complete Grade 12 and attain a certificate that allows them to proceed to tertiary education both locally and internationally. The secondary school certificate can either be the Higher International General

Certificate of Secondary Education (HIGCSE) or the International General Certificate of Secondary Education (IGCSE). Examinations written by learners at HIGCSE level are set, marked and moderated by the University of Cambridge, whereas examinations written at the IGCSE level are set, marked and moderated in Namibia. Local and international institutions have different sets of requirements for grades scored in Grade 12 subjects which will grant learners acceptance into higher education institutions (Katjavivi, 2016).

The curriculum is intended to deliver quality education; however, Ninnes (2011), questioned what quality education meant. He agreed that the Effective Schools Movement (ESM) had attempted to define the characteristics of equitable, quality schooling. Ninnes (2011) further stipulated that a school can be considered *reasonable* when it demonstrates a striving for success, a secure environment, positive home-school relations, a centred mission, and plentiful opportunities for learners to learn in order to help build quality education.

The United States school system defines quality education based on human rights principles. Mutorwa (2002) argues that factors such as teacher qualifications, efficiency, competence, resource distribution, language expertise and management have a great influence on the quality of education in Namibia. However, to overcome these challenges, the MoE had to formulate plans to tackle the problems faced in running a programme that would provide schools with libraries, laboratories and classrooms. Mutorwa (2002) argued that more teachers had to be trained to address the shortage of qualified teachers and that school governance and management had to be improved by establishing school boards and in-service training for school principals.

After independence, the newly established Namibian education system faced a challenge of teaching Mathematics, Physical Science and Biology due to the earlier regime of apartheid that had excluded most of the black Namibian children from being taught these subjects. However, after independence, the MoE made an effort to implement effective training for Science teachers to equip them better to teach Science subjects effectively (Mutorwa, 2002). He added that the MoE developed policies and sub-policies that guided the training of teachers.

The following are the major changes made to the curriculum so as to advance Science education: (i) a compulsory Mathematics and Science curriculum for Grades 1 to 10; (ii) offering Science subjects in many schools across the country; (iii) a student-centred approach for the teaching and learning of Science (iv) the writing of practical examinations (Paper 3) at the end of the senior secondary level which now constitutes 19% of the total score of the final examination (NSSC H-Level Biology Syllabus, 2006). Before the Science curriculum was reformed, practical work had not been assessed or examined; hence Science teachers who had carried out practical work had done so in whatever way they liked, while others had not bothered to include practical work instruction.

A directorate within the MoE called the National Institute for Educational Development (NIED) was developed in 1990 to be a curriculum development centre with the obligation of spear-heading fundamental education and change (Mutorwa, 2002). This institute played a part in Namibian's education systems, schools, resource centres and other institutions (Mutorwa, 2002). The new curriculum and the teaching programmes of the education system were developed, revised and put to work by NIED. The NIED had a number of various panels and committees who attended to course development and the evaluation of textbooks and educational material. As a result of the NIED's work, subject syllabi were revised and these as well as accompanying textbooks had to be translated into different African languages. From 2010, a new National Curriculum for Basic Education was established which aimed at building on the experiences, achievements and lessons learned from the first curriculum that had guided the education system since 1990. This was done to improve the education system, so as to ensure a smooth-running system. The 2010 National Curriculum for Basic Education was revised in 2017, and the revised curriculum became effective from 2018 (Mutorwa, 2002).

According to Katjavivi (2016), teachers received retraining for the new curriculum during school holidays in order for them to adjust to the curriculum. The training had to be done over a limited period, and this put pressure on teachers to familiarize themselves with the changes. A curriculum guide clearly portrays the aims and objectives of the curriculum, the content specifications, and standards of instruction, guidelines on how learning should occur,

assessments, the approach to language and guidelines for how educational programmes should be administered at school level. Katjavivi (2016) claimed that having a curriculum to follow allows teachers to learn the key areas of teaching. The curriculum guide clearly stipulates the subject combinations and electives that are available to complement the direction of the teaching-learning process that will ensure development of high-level thinking skills in a learner. Katjavivi (2016) noted that Namibia is one of numerous nations encountering science education challenges, and this requires a solid preparation for learners in secondary schools in crucial science subjects, such as Biology. He further mentioned that the need for a solid preparation stems from the inherited deficit during the time the country was gaining independence.

The Namibian Examination Annual Report for 2015-2016, shows that NIED re-assessed the teaching tools, equipment, materials and syllabi topics for both primary and secondary phases. Specifically, the NIED assessed the conditions that might have an influence on the performance of learners, and recommended numerous strategic plans in order to work on projects that would help improve the teaching and learning challenges: for example the lack of resources that is faced by teachers and learners. Since Natural Science is known to have an impact on changing the world, the MoE focused on refining the Science curriculum to guarantee that learners would acquire the fundamental skills offered in the process of learning Science. By improving the curriculum, NIED aimed at achieving the following: students would have sufficient knowledge to ask questions, make observations and would have a better understanding of the physical world. Moreover, the MoE's goal is to have learners who can utilize the information learned in Science classes to make better life choices and to improve their ways of living.

Aloovi (2016) confirmed in his study that schools face challenges such as a lack of qualified teachers, a lack of experienced teachers, poor school infrastructure, a lack of practical work resources, overcrowded classrooms and timetable overload. Teachers in rural schools experienced the challenges more acutely because they reside far from resource centres. Therefore, there has been a communication barrier between teachers from various schools since they would have had very little opportunity to meet (Aloovi, 2016). He further pointed out

that teachers had no platform in which to raise the problems that they endured with the implemented curriculum. The challenges encountered by teachers with respect to the educational curriculum resulted in the introduction of large-scale professional developmental projects that primarily focused on junior and secondary school teachers, to assist them to overcome these challenges. The first project was the In-Service Training and Assistance for Namibian Teachers (INSTANT) (Aloovi, 2016). This project was aimed at arming teachers with new skills to assist them to implement the educational curriculum.

2.3 The history of Biology

This study demonstrates a connection between South African schooling and Namibian schooling as Aloovi (2016) noted that Biology had been introduced in Namibia as a subject at the same time that it had been introduced in South Africa, with the two countries sharing the same curriculum during apartheid. According to Le Grange (2008) the introduction of Biology was brought about by developments that had occurred in Britain and the USA; these being the two countries that had developed Biology in the 19th century. Moreover, Le Grange (2008) alludes to the fact that South Africa and Namibia relied on European countries such as the Netherlands, the UK and USA for teaching materials such as textbooks.

Nwagbo and Uzoamak (2008) stated that nations may depend on science as an enterprise, to gain ground in the world of technology. It is therefore safe to claim that science education as a field is important because it is relevant to our daily lives and societies. Nwagbo and Uzoamak (2008) noted that the Biology branch as a science contributes enormously to the technological growth of the nation globally. Biology has a long history and is said to have appeared as a school subject in Britain in the 19th century after scientific subjects were introduced in the secondary school curricula in the early 19th century, according to Le Grange (2008). He notes that the leading school subjects at the time were Physics and Chemistry, followed by Botany and Zoology. Le Grange (2008) noted that when Botany was a school subject, Biology barely existed as an identifiable discipline. However, the decline in Botany as a school subject caused Biology to emerge in the curricula of some schools. Goodson (1983) argues that when Biology

was introduced as a school subject, biological science at the time had not matured yet because the utilitarian and applied perspectives of science were still undeveloped.

In a study by Le Grange (2008) on the history of Biology as a subject, he found that the Industrial Revolution in the USA had an effect on the increase in the school population growth in secondary schools, and that USA law in 1952 required compulsory schooling. Furthermore, Le Grange (2008) noted that for learners to enter university they required botany, zoology and human physiology at high school level. The immigrants who entered the USA in the late 19th century and the migration that happened from rural areas to urban areas is known to have resulted in social development. It is through this advancement of most children entering schools within the urban zones that Science was presented to cater for children's individual needs, such as teaching them how to protect themselves against disease and illness (Le Grange, 2008).

Le Grange (2008) concludes that it is evident that the formation and growth of Biology as a school subject in Britain and the USA were impacted by two aims:

i. The disciplinary aim of Biology that solely focuses on the theoretical, conceptual and procedural understanding of life (Biology as a *science of life*); and
ii. The social aim of the subject that necessitates a human-centred approach, focusing on how biological issues impact human life (Biology as a *science of living*) (Le Grange, 2008).

Le Grange (2008) outlines the impact which history had on Biology education in South Africa, and how it reminds one that *science of life* versus the *science of living* debate is not new as it has characterized school Biology since its inception. He further stresses that Biology as a subject is unceasingly affected by socio-historical variables and not as it were by developments within the field of science. For this reason it is critical to follow the history of Biology as we explore the understanding and clarification of the advancement of Science in schools.

According to Le Grange (2008), in South Africa not much has been written on the history of Biology, adding that overseas countries have, however, influenced the establishment of Biology in the country. Le Grange (2008) avers that the subject was offered in South African schools

using textbooks imported from overseas, which were available in Dutch and were later translated to English and Afrikaans after 1930. Le Grange (2008) indicates that although Biology is a subject which replaced Botany in the former Transvaal in 1935, Botany remains a strong component of school Biology, considering that plant morphology, plant systematics and plant physiology was introduced into school Biology. In his study he added that after the plant section of Biology, the study of animal physiology and classification was also included over the years. However human Physiology was offered as a separate school subject (Le Grange, 2008). Over time, the scope of the subject was enlarged to include molecular biology, ecology, genetics and other science concepts in the 1950s. The instruction of Biology was basically centred around the study of plants and animal life as these were the primary components included in Biology from the time it was first presented in South Africa (Le Grange, 2008).

In his study, Le Grange (2008) points out that the academic orientation of Biology as a subject was influenced by numerous factors. These factors include: the fact that Biology had matured as a school science subject in the second half of the 20th century; discoveries of biological scientific significance; the DNA helix; and positivism legacy, which significantly influenced school Science. Positivism is a philosophical system which recognises only that which can be proven or scientifically verified. For this reason, following the positivism trend, great emphasis was placed on laboratory work in schools as it demonstrated a lack of bias owing to a basis of experimentation. According to Robottom (1983) as cited by Le Grange (2008), when the concern was raised in Australia that qualitative dimensions in the Science curriculum had been elevated due to an artificial separation of fact and value, positivism was said to have created genuine knowledge over values.

However, Le Grange (2008) indicates that there were variables endemic to South Africa which contributed to the *science of life* approach having increased overwhelmingly in South African school Science during the last 50 years.

2.4 Biology as a Science subject

Science is clearly understood to be a body of language, a process of conducting enquiry and a regulating of interest of information of the material world (Millar, 2004). The concept is additionally characterized as an intellectual movement that encompasses the systematic study of conduct of the natural world through perception and experiment. Millar (2004) states that scientific knowledge has a unique character as it offer particular clarifications to the logical terms that construct the world. He noted that science is esteemed as a product, as an enquiry process and as a social institution since it has managed to clarify phenomena in ways that have fulfilled and proceeded to direct the utilization of objects. According to Millar (2004), the aims of science education are:

i. To help learners to gain an understanding of as much of the established body of scientific knowledge as is appropriate to the learners' needs, interests and capacities;
ii. To develop learners' understanding of the strategies by which this information has been gained, and our grounds for arriving at certainty.

Considering science as an important aspect in the education of the nation, Nwagbo and Uzoamaka (2008) alluded to the fact that it requires a successful approach of teaching that aims to advantage learners. Learners are required to upgrade their skills. For this reason, the acquisition of scientific processing skills forms the basis of scientific inquiry and the improvement of mental ability as well as the state of mind required for one to learn science concepts. Nwagbo and Uzoamaka (2008) point out that a programme known as 'Science a Process Approach' (SAPA) was developed in 1963 by the American Association of Advancement of Science's Commission with the aim of refining learners' skills within the field of science. This programme interpreted processes as being the true heart of science because it emphasises aptitudes over content. If science is seen as a development of skills, Ajunwa (2000) reported that the Nigerian research council modified science process skills as follows:

i. Observing
ii. Measuring

iii. Communicating
iv. Predicting
v. Using numbers
vi. Time relationship
vii. Controlling variables
viii. Hypothesizing
ix. Interpreting data.

Much is expected from Science learners, since they are expected to increase their skills by learning diverse scientific concepts. They are expected to develop the capacity to solve common issues that they may experience other than science-related problems. Moreover, learners are expected to gain confidence as they acquire self-reliance from Science training (Nwagbo and Uzoamaka, 2008).

According to Le Grange (2008), in the past, Biology was taken by learners who were matriculating because it was one of the most popular subjects offered in South African schools. He further states that during apartheid, Biology became a well-understood subject and was symbolized as a study of life.

Biology as a Science subject is pre-selected as a key learning area in science education. The subject is known to be a platform for learners to gain a balanced learning experience, through which they can develop different aspects of science such as knowledge, understanding and attitudes that are needed for personal development as well as for contributing towards a scientific and technological world. Biology in this sense prepares learners well for tertiary courses which revolve around Biology, such as Medicine and Health Sciences (Aloovi, 2016).

The dominant characteristic of science as a process approach is that scholars learn the behaviours of scientists. This mostly revolves around them doing what scientists do. Kurtz (1967) stated that there are fourteen science processes which may be used as ways to analyse the biological side of science, by identifying the biological activities.

2.5 The role of practical work

Practical work is considered to be a vital component in the learning of science (Hattingh, Aldous and Rogan, 2007). Similarly, Kandjeo-Marenga (2008) stressed the importance of any science researcher to have a profound understanding of what practical work is about, what it necessitates, and what can be regarded as good practice in science education. Hattingh, Aldous, and Rogan (2007) conducted a study of practical work and they agreed that practical work should be performed successfully on a daily basis. Successful practical work assists the development of learners in the following ways: at the lower level of practical work they learn scientific concepts by gaining an understanding using logical knowledge; a more advanced level of practical work is known to assist learners in experiencing how new information can be created and substantiated.

It is up to the Science teacher to decide whether or not to do practical work and the type of practical work to be done (Hattingh, Aldous and Rogan, 2007). These writers found that teachers stated that their choice to incorporate practical work into their teaching is dependent on many variables; the most notable of which is the teachers' understanding of learners. The extent to which teachers engage practical work depends on the degree of involvement and participation of the learners.

According to Ufonabasi and Nsimeneabasi (2017), practical work creates a platform for learners to fundamentally utilize their minds in learning the standards and laws of science. Literature concurs that practical work plays a vital role as it permits learners to alternate between hypothetical thoughts, thereby co-ordinating involvement. This implies that learners are anticipated to have the capacity to recognize and value scientific information as dependable, based on perceptions and reproducible experiments. This means further that learners are expected to have the ability to recognize and value scientific knowledge as reliable; to assess tests and arguments and recognise the legitimacy of experimental results (Wilkinson and Ward, 1997).

Nwagbo and Uzoamaka (2008) aver that Biology practical lessons are significant in the sense that they allow learners to understand biological concepts; enabling learners to have a strong and solid understanding of the natural world and how it operates. Learning to work with their hands and observing science may be a critical need for learners to learn successfully (Mwangu and Sibanda, 2017). According to Ufonabasi and Nsimeneabasi (2017) when learners do their own work at their own pace and level, it helps them learn to take responsibility for their own self-learning and helps them gain self-confidence. Ufonabasi and Nsimeneabasi (2017) further state that through viable exercises, learners develop individual, learning and thinking abilities. For this reason, learners require satisfactory education through a range of practical exercises to enable them to obtain fundamental, viable abilities in science concepts.

Mwangu and Sibanda (2017) postulated that practical work can effectively be respected as an excellent technique for teachers to create a genuine understanding in learners. These writers draw a comparison with teaching learners Biology theory which is based on facts, principles and subject concepts. They emphasise further that practical activities should engage learners in activities where they can physically manipulate objects, following guidelines set to facilitate this for them. Correspondingly, Hattingh, Aldous and Rogan (2007) state that learners become excited when an opportunity is presented to them to do interesting practical work, and this should be promoted by introducing innovative practices in classrooms, thereby fully engaging learners.

Literature on teaching has generally called into question whether learners learn more without teacher direction. If teachers are seen to extend their Science understanding of the distinctive concepts and information utilized in science, this increased knowledge will help learners extend their curiosity and improve their learning of Science.

Hodson (1996) argues that Science practical skills can only be acquired by linking them to the science concept for it to make sense for the learners. According to Hodson (1996) for future learning, it is important to instruct learners in the practical skills that will assist them in practising other activities in other fields of study. Learners should learn skills in order to help them in everyday life.

Capel, Leask and Turner (2009) attest that it is important for learners to understand scientific processes and structures and to develop skills in manipulation, in processing scientific information and in conducting scientific investigations. Abrahams and Reiss (2012) contend that in spite of the fact that they found it vital for learners to deal with a range of objects and materials to create desired phenomena, most of these cannot be compared to the utilization of formula-style activities. Most of the impact of the practical work lay in what learners had done and had observed and the exertion they had demonstrated within the work. An example of this was demonstrating to the teacher what learners were able to create from their observations. Abrahams and Reiss (2012) claimed to have based their study on the effectiveness of practical work at both primary and secondary schools. They found no difference between learners in primary and secondary schools with regards to the observations done.

Moreover, Kaptan and Timurlenk (2012) assert that practical work is an exclusive feature in Science subjects which is typically regarded as having an influence on improving learners' attitudes towards practical work. It mostly shows that learners tend to have a positive attitude if they show an interest in doing practical activities, as compared to mere theoretical learning. The Ministry of Education (2018) outlines the subject Biology improves the quality of the learners' understanding of the physical and natural world around them, both regionally and around the world. This incorporates how social orders utilize natural resources to satisfy their needs, and how the environment is changing in ways which encourage conservation of the natural environment. Other than that, the Science syllabus places an emphasis on the fact that scientific subjects are, by their nature, experimental.

Consequently, it is important that learners are presented with a fully integrated course, which allows them to improve their practical skills by carrying out practical work and inquiries within the syllabus objectives to achieve the targets. Basic considering, exploring phenomena, interpreting information, and applying knowledge to practical (experimental and investigative) skills are crucial to understanding the worth and limits characteristic of common substances, methodologies and methods, and their application to our ways of life. This requires progressed development through the practical and successful utilization of resources and processes.

Progressed advancement is required in order to help learners and broader society to illuminate issues through the arranging, planning, affirmation, and assessment of targets (Ministry of Education, 2018).

Similarly, the Ministry of Education (2010) outlines the practical aims of Biology as follows:

- Provide, through well-designed studies of experimental and practical science, a worthwhile educational experience for all learners, whether or not they go to study Science beyond the secondary school level, and to enable them to acquire sufficient understanding and knowledge in order to:
    i. Become confident citizens in a technological world, to develop an informed interest in scientific matters;
    ii. Recognise the usefulness, and limitations, of the scientific method and to appreciate its applicability;
    iii. Be suitably prepared for studies beyond NCCS level in pure Science.

- Develop abilities and skills that:
    i. Are relevant to the study and practice of Biology;
    ii. Encourage efficient and safe practice;
    iii. Encourage effective communication.

- Develop attitudes relevant to Biology such as:
    i. Objectivity;
    ii. Enquiry;
    iii. Initiative.

- Stimulate interest and care for the environment.

Through Science instruction, learners are said to become acquainted at first hand with Science education, especially with scientific inquiry and conceptual knowledge through the learner-centred strategy of investigation. For this reason, the learning process is considered to be more important than a teacher-centred strategy. A teacher-centred strategy does not effectively

include learners in learning, which in turn makes it difficult for them to explore the topic completely.

Lee and Sulaiman (2018) argue that practical work can serve as a useful platform to develop a positive effect on learners' motivation and understanding towards learning. Practical work also fosters interest, new experiences, excitement, and a better understanding of a subject in learners, which in turn increases their ability to collaborate with peers, and it becomes a great motivation to improve their performance as they gain confidence in subject content, motivation and understanding Science generally. In agreement with what was said by Lee and Sulaiman (2018), the current researcher postulates that Science education cannot be complete without practical work. Therefore, there is no doubt that practical work is a fundamental part of the teaching and learning of Science. Due to the fact that practical work helps learners to expand their essential Science knowledge, it elevates their motivation and understanding of scientific theories as related to practical work and concepts about the natural world. There can be no doubt that practical work is essential in learners' accomplishment of the above-mentioned objectives.

It is well-known that learners incline towards practical work over any other learning strategy, because doing practical work gives them a chance to see objects and manipulate them physically as opposed to just seeing them presented in textbooks or on the internet. Seeing them physically also gives them a chance to learn how they operate when they manipulate them physically, as opposed to merely memorising these facts from verbal teaching. Nonetheless, practical work cannot provide full guarantees that learners will learn and achieve all required practical objectives from teachers. Millar and Abrahams (2009), state that learners are able to retain only particular surface subtle details of a practical activity after weeks of doing the activity. Most learners could hardly recall what they had learned and the reasons for carrying out the practical task.

Practical work is vital only when it is used competently. Jones, Reed and Jonathan (2016) state that to ground a learner's understanding of the learned theory in a subject such as Biology, it is a requirement that learners be given a chance to have a glimpse of real life examples of

specimens, organisms, equipment, and processes. Learners will then understand the Science concepts through the scientific processes required and used in the laboratory during practical sessions. These writers believe that it is vital to endorse work in Science because it:

i. Stimulates creativity, curiosity and critical thinking;
ii. Underpins and illustrates concepts, knowledge and principles;
iii. Promotes student engagement with the scientific method;
iv. Encourages active learning and problem-solving;
v. Allows collaborative working;
vi. Provides opportunities to collect and analyse data and apply mathematical skills.

To achieve a compelling practical lesson, the teacher is required to convey work of extraordinary quality. Successful delivery requires the acknowledgment by education/school administration that practical Science teaching requires commitment to the proficient advancement of staff and fitting resourcing. In spite of the fact that the significance of practical work in school Science is broadly acknowledged, it is crucial to guarantee that such practical work truly aids teaching and learning. Teachers should be granted the adaptability to do this in the best way to meet their learners' needs.

Marques, Praja and Thompson (2010) allude in their study of science to the fact that currently practical work is the centre of the aims and procedures of science education. Their study also shows that when they questioned teachers about Science implementation and conceptualisation, they gave their answers based on their experience, mentioning practical combination aims as follows:

i. Practical work is the best method to motivate learners.
ii. Practical work develops scientific attitudes and
iii. Practical work assists learners in achieving a proper understanding of scientific concepts.

Marques, Praja and Thompson (2010) agree that practical work develops general skills that can be used by pupils in their daily lives; not only in science-related aspects but also to solve everyday problems. However, there is some doubt about how the ability to use laboratory

equipment such as a microscope can be transferred from the laboratory where it is manipulated, to an everyday life context (Marques, Praja and Thompson, 2010). Practical work helps learners link two domains of knowledge: real life and observable objects and the domain of ideas (Millar, 2004). The domains assist learners in accomplishing these targets: learners identify objects and become familiar with them; learn a concept; learn a fact; learn a relationship that might be a drift connecting two or more observable characteristics or properties of objects given in a specific circumstance and finally, learn a theory. In doing this, learners learn and take note of objects permitting them to review what they have learned. Moreover, learners improve their scientific knowledge.

Millar (2004) argues that all practical work done involves both domains, although one domain may be more effective than the other. The domain of ideas plays a vital role particularly in learning concepts, relationships and theories. Millar (2004) noted that the chances of a learner grasping a new concept or understanding a theory as a result of a practical activity is minimal. For learners to understand a learned concept they may have to undergo a process of obtaining a more profound and expanded understanding of an idea (Millar, 2004). He further argues that:

> Practical work to develop students' scientific knowledge often requires students to make links between two domains of knowledge: the domain of objects and observables, and the domain of ideas (Millar, 2004).

This kind of practical work is likely to be most effective when:

i. The learning objectives are clear, and are relatively few in number for any given task.
ii. The task design highlights the main objectives and keeps 'noise' to a minimum.
iii. An explicit strategy is used to stimulate the students' thinking beforehand, so that the practical task is answering a question the student is already thinking about.
iv. The task design 'scaffolds' students' efforts to make links between the two domains of knowledge (Millar, 2004).

In addition, Sakwa (2017) in a study conducted on students' and teachers' recognition of perceptions of Physics practical work, demonstrated that practical work helps develop a range

of practical abilities and procedures. Another finding appeared to show that practical work is done to assist learners to create a routine of working as scientists and to prepare them for practical examinations.

2.6 The place of practical work within the science curriculum

In the Science curriculum, every Science subject ought to engage learners in practical activities. According to Millar (2004), learners are generally required to do practical work when they are seen not to have observed the phenomena or not to have reached an adequately detailed target. He implied that practical work is essential within the teaching of Science, clarifying further that practical work could be the central focus in science because it characterizes the science feature.

Millar (2004) noted that according to the national curriculum documentation of England, the stages 3 and 4 outlined in the document use the term *practical and enquiry skills* when referring to practical work.

The document specifies that teachers should teach learners the following:

i. Plan to test a scientific idea, answer a scientific question and solve scientific problems.
ii. Collect data from primary or secondary sources, including using ICT sources and tools.
iii. Work accurately and safely, individually and with others.
iv. Evaluate methods of collection of data and consider their validity and reliability as evidence (p.222).

Learners are required to have the capacity to arrange and carry out practical and investigative activities. Above all, teachers are expected to offer learners a fair chance to do an activity to test their level of interest in Science (Millar, 2004).

Millar (2004) added that although the practical and investigative activities that are required are specified in the curriculum and in accordance with research done, teachers indicate how strongly they support the importance of practical activities to learners. With this said, many schools present a gap between policy and practice, between the document statements and

what teachers advocate and what learners experience. In agreement, Tamir and Lunetta (1981) noted that there is a shift in the learning outcomes, because of the chasm between what a teacher expects from learners, what they set as outcomes for the lessons and what learners grasp from the lesson.

Tamir and Lunetta (1981) confirm that the Science curriculum aims to improve the quality of practical work. This might decrease the amount of time learners take in following formulas and practising lower level abilities. For this reason, learners fail to gain the understanding of procedures which teachers aim for learners to achieve. The Namibian curriculum states that learners utilize strategies and skills to create straightforward scientific models on the premise of existing and new data. They communicate their investigations, analyses and conclusions utilizing scientific and numerical dialect and hypotheses. They sum up and apply scientific information to ordinary circumstances. They understand the value and vulnerability of the natural environment, activities influencing the environment adversely, and how these can be argued against.

2.7 Practical work and teachers' attitudes

The construct *attitude* has been described as the behaviour a person adopts toward other people, things, incidents, or happenings. In science education, it is noted that learners' performance is highly influenced by attitudes. According to Yara (2009), the attitude that a teacher has in delivering a lesson, including the teaching strategy used, has a great influence on learners' attitudes towards the lesson content. For the learning of Science to occur successfully to the advantage of the learners, there should be a strong interplay between the teacher and learners. Most learners do not benefit from a one-way delivery technique from the teacher to learners and therefore practical work is important as it creates an interaction between teachers and learners.

Moreover, Yara (2009) described *attitude* as a behaviour adopted by a person toward other people, things, incidents, or happenings. In science education, attitude is an important contributing aspect influencing the accomplishment of Science learners. Teacher attitude or the

attitude of a learner towards practical work, affects performance. According to Ogembo, Otanga and Yaki (2015), the attitude the teacher displays when delivering a lesson, including the instructing technique utilized, has a great impact on the learners' state of mind towards the lesson content. So also, the way an attitude is communicated may lead to either positive or negative results. The current researcher postulates that a teacher's attitude can effectively impact a learner's state of mind. Abudu and Gbadamosi (2014) state that a common hypothesis with respect to teachers' attitudes and learner achievement is that learners taught using the right approach or right attitude have high performance scores.

The learners' achievements are strongly affected by the attitudes with which the science subjects are delivered. Hattingh, Aldous and Rogan (2007) add that teachers' attitudes towards innovation in the school are to a certain extent important. A school that is strongly in favour of development appears to be working well and this empowers Science teachers to profoundly involve practical work. These authors state further, in a state where learners have a durable impact in propelling their teachers to supply higher levels of practical work, they recommend that teachers should be trained in imaginative ways to carry out practical work at a much higher level for the advantage of learners. If learners show a level of excitement in this practice, teachers are automatically motivated to engage in practical work.

According to a study conducted by Hailombe (2011), the EFA Global Monitoring Report 2005 defines *quality* as a set of desired characteristics of learners. This merely refers to (the motivation and health of learners), processes (competent teachers using active pedagogies), content (relevant curriculum) and systems (good governance and equitable resource allocation). Willemse and Deacon (2015) confirm that quality education is easily hindered by the negative attitude of a teacher in the teaching and learning processes. Learners' interest in science has declined significantly and this was expected to have an impact on the teachers who taught Science subjects. This diminishing of interest in Science has an impact on the lack of interest shown in science-related careers as a choice.

According to Chawla, Jain and Mahajan (2013) *attitude* is a way of looking at things. However, the definition of the term *attitude* is vague but the term may be defined as an inclination to

reply in a positive or ominous way with regard to a given attitude object (Oskamp and Schultz, 2005).

A study by Willemse and Deacon (2015) focusing on teachers' attitudes towards their work, indicate that there are components that impact on the attitude of a teacher. In most cases a strong support system behind a teacher is what pushes and enhances a positive attitude of teachers towards their work. The support system is anticipated to be given by the school administration, learners' guardians and the community around the school, in order to assist teachers to deal with everyday challenges. Besides, other perspectives such as a friendly working environment, taking into consideration the environment on school grounds and acceptable conduct from learners, assist teachers to create a positive attitude, and to develop a love of their work. In order to foster a positive attitude in teachers, a career development process should be in place at work. Job security, satisfaction and commitment are important for career development. These three factors will help teachers build a positive attitude towards their work generally and towards practical work specifically (Willemse and Deacon, 2015). Studies reveal that attitude can be affected by an individual's background, experience and character and other factors such as relationships amongst people.

2.8 Effects of teacher attitude on learners' Biology performance

Nacionales, Muyong, and Gavasan (2015) define *science* as a way of knowing and understanding through exercises of reason and a construction of the mind based on actual observation, to explain natural phenomena. These authors allude to the fact that learners' attitudes towards Science are based on the way the subject is taught at all levels of education. Studies have shown that there should be a mutual interaction between a learner and a teacher, if mutually positive attitudes towards content are to exist.

Johansson, Heldt and Per (2006) conducted a study on attitudinal traits and choices and hypothesize that people have different attitudes towards all situations. This can, however, lead one into contemplations and a lack of security in situations they may find themselves. When teachers adopt a learner-centred approach to convey a subject theme, this has an effect on

teachers' attitudes towards the academic accomplishment of learners. In this case, teachers' attitudes can, however, have an effect on learners, in various academic ways. Abudu & Gbadamosi (2014) believed that there is a need for a close relationship between a teacher and his/her learners for good interaction. Ninnes (2011) stated that if the teaching and learning processes occurring in a subject are of a poor quality, the scores from examinations written by learners, compromises up to 50% of the mark towards promotion. This raises the chances of having a high number of learners who do not reach the required level of competency.

Madukwe, Onwuka and Nyejirime (2019) contend that attitude is a major determinant of a person's behaviour in affecting the way a teacher relates to learners, which in turn influences the academic performance of a learner. Hinneh (2017) noted that learners consider practical work an important component of their science education. He argues further that his study concluded that practical work is seen as an important aspect of Science education because learners showed a positive attitude towards practical work.

Learners gain confidence in learning through the attitudes and behaviours portrayed by their teachers in the process of teaching, which includes the teaching methods used in presenting a lesson (Ulug, Ozden and Eryilmaz, 2011). A positive relationship between a teacher and a learner creates a good communication platform. Madukwe, Onwuka and Nyejirime (2019) note that an attitude involves aspects such as feelings, opinions and dispositions which affect the way a learner behaves in a class. He adds that the behaviour of children determines how successful they can be, as it will affect the goals they have set for themselves. Ulug, Ozden and Eryilmaz (2011) expressed the view that a teacher's attitude certainly affects the performance of learners in his/her class.

Similarly, the way a teacher responds to a learner endorses the atmosphere amongst learners in a classroom. So, if a teacher responds negatively to learners in the classroom, he or she sets a bad example for other teachers and learners in the school (Madukwe, Onwuka and Nyejirime, 2019). In the same vein, the attitude of learners towards subject knowledge can be impacted by the attitude of teachers and their methods and teaching strategies (Madukwe, Onwuka and Nyejirime, 2019). The teaching strategies as well as the personality of the teacher account

greatly for a positive attitude towards the subject. Madukwe, Onwuka and Nyejirime (2019) explain that when a teacher lacks curiosity about and positivity towards the subject, it reduces the performance of learners. They further agree that it is important for a teacher to create a positive relationship with learners and to set activities which require learners to participate actively. An interested and steady educator promotes a productive learning environment which is profoundly recommended. Negative attitudes portrayed by teachers result in a decrease in learners' marks. Learners are deprived of the opportunity to ask questions in class because the teacher's attitude does not allow this.

Ulug, Ozden and Eryilmaz (2011) noted that it is essential for teachers to have good communication with their learners. Studies show that learners' interpersonal skills somehow depend on their teachers. They added that the teacher's ability to connect with a learner, by portraying positive conduct and showing interest in the learner's concerns, may expand the learner's inspiration and success, which in turn leads to positive results. Through teacher-learner interaction, learners are motivated by their teachers through their actions and attitudes. Failure results from negative attitudes whereas positive attitudes promote success. Negative ego attitudes result from failure while a positive ego results from success (Ulug, Ozden and Eryilmaz, 2011).

Ulug, Ozden and Eryilmaz (2011) stated in their review that literature confirms that learners' performances are affected by many factors other than just their hard work and effort. The primary factor influencing learners' performance is the attitude portrayed by teachers conveying subject knowledge. Therefore, a teacher's positive state of mind influences learners' inspiration, state of mind and school work; which ultimately influences learners' assurance and self-esteem. Furthermore, teaching is more than just talking and explaining. Learners require positive expectations and strong support. The same study confirms that learners' positive experiences of learning are derived from positive expectations.

Hinneh (2017) concluded that although learners may portray a positive attitude towards practical work, in terms of importance, they gain very little motivation to pursue Biology careers from the experience gained from practical work. In addition, the way in which practical

work is carried out has an impact on how learners execute the work (Hinneh, 2017). Ulug, Ozden and Eryilmaz (2011) acknowledged that in the education system, it is a condition for a teacher to be in a favourable teaching environment in order to gain good results. They concluded that these teachers are excellent communicators. They are teachers who know how to handle their learners, since they study them and understand their feelings, interests, fears, worries and more important, offer them complete support in various aspects of life. Teachers should foster in learners a feeling of acceptance and love (Ulug, Ozden and Eryilmaz, 2011).

Finally, Ulug, Ozden and Eryilmaz (2011) conclude that teachers are second only to the learner's parents as a deciding determinant for the improvement of the individual. They stress that children look up to their teachers which may be why the conduct and attitude of teachers has a greater impact on children's personalities than those of their parents, because more time is spent with teachers than with their parents. Teachers exert a great influence since their views on life and their conduct guide their learners. A supportive learning environment is highly recommended and this develops from an interested and supportive teacher. Studies show that a learner gains low marks when confronted with a teacher's negative attitude in class, as this limits learners in asking questions and limits their levels of understanding.

2.9 Learners' motivation in learning Biology

The nature of the study of science requires practical work. Practical work is of great interest to learners; they are always eager to participate. For this reason, Gudula (2017) encourages practical work to be conducted in order to assist learners to understand science. According to Gudula (2017), motivation has a great impact on the results attained by learners, if learners are not motivated to do practical work, they will do it because they have to, thus leading to poor performance. Since learner motivation is highly affected by the teacher, it is important for teachers to have positive attitudes and views towards practical work in order to motivate learners to carry out practical work and in the end perform well. The quality of living has been improved by science; has improved humans beings' understanding of how the universe operates and how competition develops in the world of science (Nacionales, Muyong and Gavasan, 2015). It is, therefore, important to know what motivates the learning of science

concepts across the globe. *Motivation* has been defined as the process whereby goal-directed activities are introduced and maintained.

As human beings, we are driven by the concept of motivation daily, since it infuses our lives at different levels. Nacionales, Muyong and Gavasan (2015) assert that the level of interest for learners to learn is questionable. This can be answered by how motivated learners are. They argue further, that learners' motivation is not determined by actions or by their performance. Lee and Brophy (1996) stressed the fact that motivation greatly contributes to a learner's Biology performance. They state further that although motivation is a latent variable, it is hard to evaluate, but is still considered important as it helps one to instil information in the mind. Learners whose performance is low are said to have low motivational beliefs. This was confirmed by Mert and Ekici (2015) in their review.

Nacionales, Muyong and Gavasan (2015) point out that the strategies used by learners in their learning processes can be used to determine their academic success in the field of science. Hornstra, Mansfield and Veen (2015) emphasised that teachers offer assistance by shaping the learning environment for motivational reasons. They further assert that teachers' motivational techniques may vary.

According to Cook and Anthony (2016) there are two types of motivation:

i. *Extrinsic motivation* refers to a distinct reward for doing something, such as rewarding somebody for excellent results. It is regularly utilized in classrooms, in spite of the fact that its viability has been questioned, since verbal praises and unexpected rewards are said to have a negative impact on other sorts of motivation. Writers further clarify that the use of extrinsic motivation enables learners to appreciate how important rewards, acclaims and attention are. Tokan and Imakulata (2019) agree that extrinsic motivation does not have as great an effect on learning behaviour, as does the intrinsic behaviour. They allude to the fact that factors such as parents' encouragement of learners, infrastructure and social communication also do not drive learners to read books, visit the library, surf the internet and attend classes and therefore have no influence on the learning behaviour of learners.

ii. *Intrinsic motivation* refers to the instinctive pleasure which learners gain when they learn something new or succeed at a challenge.

Cook and Anthony (2016) propose that intrinsic motivation can be enhanced in the classroom by using the following:

i. Challenge (a moderate level of difficulty will allow students to experience a sense of mastery and competence when they succeed);
ii. Curiosity (students are interested in resolving inconsistencies in their experiences, such as learning why a penny sinks but a feather floats);
iii. Fantasies (allow students to use their imagination to step out of real life);
iv. Control (students are more likely to be motivated when they perceive themselves to be in control of their behaviour).

Tokan and Imakulata, (2019) conducted a study on the effect of motivation and learning behaviour on student achievement and state that with regard to intrinsic motivation, the learning behaviours of learners are influenced by factors such as interests, ideals and ability, which in turn help learners to develop habits of reading books, surfing the internet, attending classes and preparing for examinations well in advance; which then in turn help improve their performances. According to Tokan and Imakulata, (2019) learners develop these habits and increase their desire to study Biology; while some aspire to become Biology teachers. Intrinsic motivation is a driving force that arises from within learners in the form of desire, aspiration and ability. This may even take the form of the wish to become a Biology teacher as Tokan and Imakulata (2019) described. Similarly, these writers described intrinsic motivation as one's encouragement from within, which is related to satisfaction. Concluding their study on intrinsic motivation, Tokan and Imakulata (2019) argued that the learner's behaviour arises from a strong intrinsic learning motivation.

There are other theories that are of varying importance with regard to the learning process as they have a different effect on the cognitive process. According to Cook and Anthony (2016), the theories are as follows:

i. Expectancy-value theory: describes motivation as a function of the expectation of success and perceived value.
ii. Attribution theory: focuses on the casual attributions that learners create to explain the results of an activity, and classifies these in terms of their locus, stability and controllability.
iii. Social-cognitive theory: emphasises self-efficacy as the primary driver of motivated action, and also identifies cues that influence future self-efficacy and support self-regulated learning.
iv. Goal orientation theory: suggests that learners tend to engage in tasks with concerns about mastering the content or doing better than avoiding failure, which arises from a fixed mind set.
v. Finally the self-determination theory: proposes that optimal performance results from actions motivated by intrinsic interests or extrinsic values that have become integrated and internalised.

The above-mentioned motivations are promoted by the basic psycho-social needs of autonomy, competence and relatedness.

Cook and Anthony (2016), state that learners are motivated differently with reference to the above-mentioned theories. He further states that motivational beliefs that define the expected success (goals, self-concept and task difficulty) and task value in a learner's perspective are shaped by social influences such as the teacher, parents or other learners as well as things that happen generally in one's life and the environment. According to the two authors, studies done outside medical training show that a learner's success expectancy is influenced by the choices of topic study, the degree of involvement in learning and accomplishment. Cook and Anthony (2016) further postulate that task value is associated with the choices made and expectancy is associated with how much one is engaged, the depth of processing and learning achievement.

A theory by Bandura (1986) states that human action comes from complementary interactions between three components which are known to be: *personal factors* that include beliefs, expectations, attitude and biology; *behavioural factors* and *environmental factors* (Cook and

Anthony, 2016). In addition to this, they note that learners appear to have different goals as individuals. Some learners have mastery goals that help them uplift their intelligence and abilities. These learners are believed to improve throughout the learning process. They are driven by a mind-set of people who become smarter through practice and studying; therefore, they seek learning opportunities because they believe they will become smarter. With this, learners are motivated to do better, which in turn improves their performance. Learners with this mind-set are often triggered to take up challenges, without feeling guilty because they understand the *no pain, no gain* concept. Cook and Anthony (2016) elaborate on the fact that learners gain confidence when facing challenges; even those with low confidence levels choose challenging tasks which make them feel smart when they engage fully in learning.

According to Nacionales, Muyong and Gavasan (2015), research shows that there are factors found to be relevant in describing motivation related to theories of self-concept. Self-concept and learning are said to have an effect on each other (Nacionales, Muyong and Gavasan, 2015). These authors stress that aspects such as motivation, achievement, attribution and goal orientation contribute greatly to learners' abilities to apply themselves to their education. Programmes have been designed which are aimed at helping to improve learners' performances and to encourage their drive to learn. Regarding the failure of learners, attribution change programmes have been designed to help reduce failure rate. Feedback from this programme improves self-efficacy, motivation and skills acquisition (Nacionales, Muyong and Gavasan, 2015).

2.10 Challenges faced during practical sessions

Just like anything else in this world, practical work also comes with challenges, which obstruct the learning and teaching process. Dillon (2008) stipulated that the quantity of practical work done in schools has decreased over the years. This could be due to countable facts and obstructions. Practical work is marginalised by the key phenomenon that 'teaching is done to test' (Dillon, 2008). He mentions further, that teachers are expected to achieve good examination results and one response to this has been to concentrate more heavily on

theoretical learning which is more doable and considered rather than focusing on practical work that requires a lot of time and administration.

Hodson (1992) in his study which explores some directions for change in Science practical work stipulated that favourable learning outcomes are not guaranteed by having access to the necessary practical facilities. He adds that in most cases teachers are limited in the practical work sessions due to some of the following reasons: scarcity of facilities, poor technical support, poor laboratory design and limited time dedicated to the curriculum. Furthermore, he stresses that teachers have insufficient opportunity to study and learn the activities before lessons; and that they have too many learners in one practical class. Hodson (1992) stated that learners' behavioural issues may arise when the class is too big, because control is difficult.

Malathi and Rohini (2018) agree that inadequate time allocation for practical work is an obstruction, as is the unavailability of resources and a large number of learners per class, which makes it difficult for a teacher to give undivided attention to a single learner at a time. The authors add that teachers are pressured to follow the assessment of theory activities, which erodes teaching time. These are contributing factors that hinder effective practical work. The absence of suitable venues, favourable environments, technical support and laboratory assistants are by far the most significant problems faced by teachers (Malathi and Rohini, 2018).

Kapting'ei and Rutto (2014) mentioned that learners should be able to develop different skills such as thinking skills and process skills. Adding to this, learners often have difficulties in achieving scientific skills because they lack the understanding of practical concepts. Because of this, they face the following challenges:

i. Lack of laboratories in schools.
ii. Limited laboratory space.
iii. Lack of laboratory technicians.
iv. Inadequate laboratory equipment.
v. Limited time to spend on practical work.
vi. Limited practical manuals.

vii. Lack of funds available for equipment repairs.

viii. Poor understanding and grasp of practical concepts by learners.

Kapting'ei and Rutto (2014) outlined challenges faced in accomplishing Physical Science practicals in Kenyan secondary schools. The study shows that most practical work is hindered by the challenges mentioned above. Challenges such as: a lack of laboratories in schools is common globally. Childs, Flaherty and Limerick (2016) define a *laboratory* as a place where learned effort is used to solve scientific problems. Not having laboratories on school grounds puts the lives of learners at risk, because some practical work requires learners to use explosive chemicals that could harm learners, and he suggests that the risk of such experiments is diminished when done in a laboratory (Kasiyo, Denuga and Mukwambo, 2017).

Having no laboratories makes it difficult for teachers to keep the limited apparatus safe, thus putting them at risk of damage, which will result in a reduction of the few that are available. Kapting'ei and Rutto (2014) mention that some schools appear to have quite limited laboratory space that cannot accommodate the number of learners in a class for the practical sessions, thereby reducing the productivity of the practical work learners must do. Teachers in some instances may be forced to divide learners into groups to fit into the laboratory and to have sufficient access to practical equipment. Working in shifts may be time-consuming, thus leaving practical work unfinished as per the syllabus requirement. Learners easily learn scientific skills from practical activities when the laboratory is well-equipped and has the resources needed for practical work. Kapting'ei and Rutto (2014) state that more than seventy-percent of the schools visited during their study lacked sufficient equipment. Nghipandulwa (2012) noted that most schools in Namibia have laboratories which are poorly equipped. For this reason, opportunities to do the practical work required by the syllabus are limited. Furthermore, learners are deprived of learning science concepts as per the syllabus requirement.

Kandjeo-Marenga (2008) stated that many Biology practical activities are not carried out due to a lack of practical work resources. Kasiyo, Denuga and Mukwambo (2017) point out that Namibian schools face a scarcity of equipment and resources which is the greatest negative factor faced by teachers, as it hinders their teaching process. They noted that teachers

expressed their willingness to incorporate practical teaching and learning, but they are limited by the lack of equipment. This greatly demotivates teachers, as they realize they are not adhering to the syllabus objectives. However, Hattingh, Aldous and Rogan (2007) strongly disagree that the lack of laboratories, resources, science apparatus or portable laboratory stations are challenges, because they believe that a teacher who is interested in doing practical work will always find a way to do it. This can be done by finding alternatives or even going to the extent of borrowing apparatus from other schools. Equally, teachers who may not be interested, will not carry out practical work even if they happen to have access to the equipment (Hattingh, Aldous and Rogan, 2007).

Adding to the lack of sufficient equipment, Kapting'ei and Rutto (2014) state that some schools have very old and dysfunctional equipment and teachers claim that there is a lack of sufficient funds to replace the old equipment. Schools also face the challenge of a lack of trained laboratory technicians, who lack the necessary technical skills and professionalism. According to Kapting'ei and Rutto (2014) some schools do not have laboratory assistants at all, making it difficult for teachers as they are forced to do the work of a technician and waste the time required to teach and demonstrate practicals. Lastly, their study established that teachers in some schools mentioned that they avoid practical instruction and concentrate on theory instruction, thereby reducing the practical instruction coverage of the syllabus. Namibian schools barely require laboratory assistants as most of the practical work is set up by the teachers themselves (Kasiyo, Denuga and Mukwambo, 2017). Teachers lack the expertise to set up practicals, because they are not sufficiently competent to conduct practical work using modern methods. Forty minutes is the time allocated to a period and this is insufficient time for a teacher to carry out a practical with a lot of learners. It is difficult to accommodate each learner, especially in a setting where resources are limited and may need to be shared. Kasiyo, Denuga and Mukwambo (2017) explained that the sharing of resources amongst learners reduces the opportunity of each learner to explore, learn and understand the practical content, because time does not allow it. Teachers also complained that compulsory management meetings that are called during period hours waste much of their time (Kasiyo, Denuga and Mukwambo, 2017).

Kaptan and Timurlenk (2012) stated that it is very important to have sufficient time to prepare for a practical activity, as it allows enough time for correctly setting up and also allows learners time to prepare for the activity. This is to ensure purposeful practical work and for accurate feedback to be given to learners. A review of science literature shows that teachers place emphasis on safety risk assessment and health safety with respect to practical activities although these require time, which in many cases is limited. In the same vein Mwangu and Sibanda (2017) stated that schools in Zimbabwe have a lack of Science teachers, a lack of materials, a lack of funds and have limited time allocated to Biology practical lessons. Furthermore Mwangu and Sibanda (2017) stated that the inadequacy of instructional materials such as apparatus, chemicals, local specimens, and a shortage of textbooks contribute to the poor results attained by learners. In most studies consulted, schools face similar challenges across the globe.

Nonetheless, Ninnes (2011) agreed that, in order for teachers to teach well, and to receive constructive feedback, they need access to resources. In a case where a school is well-resourced, learners learn well, and it increases the chances of them developing the desired competencies. Furthermore, Ninnes (2011) pointed out that NIED of the Namibian education system established a sound programme of teacher development and the Continuing Professional Development unit is in the process of being developed. However, teachers' teaching progress is still assessed in order to make necessary improvements. Furthermore, secondary school learners are required to provide feedback on the quality of teaching that they receive, in order for necessary adjustments to be made. However, good results require quality education which in turn results from an improved teaching approach (Ninnes, 2011).

2.11 Scientific language during practical work instruction

Language is a significant component in Science teaching as it creates a good understanding between a teacher and a learner. Therefore, Kandjeo-Marenga (2008) postulated that the use of language in teaching and learning cannot be disregarded, because it is vital in creating a platform for learners and teachers to express scientific ideas. Although language is not only important for Science subjects, Namibian Science teachers are advised to use English as the

medium of communication, in order to accommodate all learners, since English is the official language in Namibia. According to Gudula (2017), as curriculum developers, teachers should create a correct form of instruction between them and learners for good communication purposes. He concluded that this is especially important for those learners whose home language is not the medium of instruction. When using English as a medium of instruction, this makes it easy for those learners to understand and follow the teacher.

Learners could face challenges in using their second language in Science education, because of cultural differences, educational and economic disadvantages, and conceptual difficulties. Real language difficulties caused by a second language may cause learners problems in understanding subject content brought about by this language barrier and they cannot be judged for that (Rollnick, 1998). Scientific language cannot be categorized as a neutral language, considering the fact that learning it requires not only familiarizing oneself with it, but learning a lot more about it (Kandjeo-Marenga, 2008).

Hodson and Hodson (1998) identified the thematic pattern that is considered in learning the language of science. They defined *thematic patterns* as ways in which scientific concepts and ideas relate to one another in a network of inter-dependence of meaning. They further argue that it is important to familiarize people who join the scientific community with the distinctive attributes of scientific language, technical terms and the symbols of science, to make their scientific communication easy. Hodson and Hodson (1998) claim that:

> The notion of apprenticeship implies that students will learn the language of science by interaction with someone who is already an expert and by using it themselves in carrying out authentic tasks. Thus, teachers should model appropriate language use, make explicit reference to its distinctive features, provide language-based activities that focus on them, create opportunities for students to act as autonomous users of the language, and provide critical feedback on their success in doing so (p.22).

Lijnse (1995) noted that Science teachers may use a complex science language or simple scientific terms when addressing science subjects, but they should always consider the audience they convey the message to. Lijnse (1995) emphasized that teachers do not find it

easy to avoid understanding each other in a social setting. This implies that all through the educating and learning process there should be a shared communication between teachers and their learners to make learning simple. He concluded that information is customarily passed on through clear statements and sentences. Learners will understand the implications of the explanations made in a language they are familiar with, because the concepts and terms are clear to them. There should be a clear association between the learning process and the scientific language to give learners a chance to practise their scientific skills (Lijnse, 1995).

Sutton (1998) stated that scientific language is used as a communication tool between a teacher and learners and should be maintained for better understanding. He added that learners are led and facilitated by the teacher through the language used vocally and through writing. Sutton (1998) claimed that in most cases, a teacher's explanatory tone reflects learners' learning.

According to Gudula (2017), the connection between practical and theory learning in Science is language. Learners may do experiments aimed at investigating a concept, but without language they will not retain it, because the experimental procedures to be followed are outlined in the teaching and learning language chosen for the learning process. Gudula (2017) noted that this may challenge learners whose spoken home language is not the medium of instruction. It was also noted that scientific language contains many unique terms which do not make communication easier.

Gudula (2017) supports Hornberger (2002) who outlined the use of multiple languages for recognition in teaching and learning in order to increase linguistic resources that will ensure effective learning. Having multiple languages recognised will promote learners' ability to understand the subject content fully, rather than having to memorise it without understanding, which is caused by language barriers. Gudula (2017) argues that teachers tend to create learning patterns by using mnemonic devices. He argues further that this approach promotes memorization learning rather than learning to understand the Science content.

Any kind of learning is said to involve using new language, which is needed to help learners make sense of what they observe and hear when learning (Sutton, 1998). He urged teachers to

use scientific language in the examples that they give to learners in order to help learners experience using a language set as medium of instruction in subject matter as this too will boost their understanding of science.

2.12 Practical assessment methods

Doran, Lawrenz and Helgeson (1994) defined *assessment* as the collection of quantitative and qualitative information about student learning using a variety of methods or techniques. Abrahams and Reiss (2012) described the significance of the Science curriculum and how it is linked to the practical activities assessed by the teacher. Doing practical work as an essential process enhances learning Science and helps learners develop scientific skills. Studies show that quality education is assured by assessing learners' activities to check and weigh their learning progress as they demonstrate their scientific knowledge. The Ministry of Education, Arts and Culture (2018) in Namibia state that Science subjects by their very nature require experimentation; therefore, it is imperative that learners are assisted to follow a completely integrated course, in order for them to create the fundamental practical skills required when carrying out practical investigations. It is for this reason that assessment is regarded an important component in the education system (Sedumedi, 2017). Inasmuch as assessment is important, it should not only be used as a tool for checking progress in learning, but should also assist in improving the quality of education (Saddler, 1998).

The Ministry of Education. Arts and Culture (2018) states that practical work requires learners to be able to do the following in order for them to be assessed:

- demonstrate a knowledge of how to use apparatus and materials safely (including following a sequence of instructions where appropriate);
- plan experiments and investigations (including how to record accurate estimates, observations and measurements accurately and make deductions from simple tests);
- handle and process experimental observations and data (including dealing with anomalous or inconsistent results);

- apply scientific knowledge and understanding to make interpretations and to draw appropriate conclusions from practical observations and data; and
- evaluate methods and suggest possible improvements.

Furthermore, the Namibian secondary school syllabus requires learners to write practical examinations, designed to test the learners' familiarity with laboratory practical procedures. The Ministry of Education Arts and Culture (2018) states that examination questions should be set in order to require the learners to:

i. carefully follow a set of instructions;
ii. record readings from diagrams of apparatus, including reading a scale with appropriate accuracy and precision, interpolating between scale divisions and taking repeated measurements, where appropriate, to obtain an average value;
iii. describe, explain or comment on experimental arrangements and techniques;
iv. interpret and evaluate observations and experimental data;
v. complete tables of data, and process data, using a calculator where necessary;
vi. perform simple arithmetical calculations, including the magnification (enlargement) of a drawing;
vii. plot graphs and interpret graphical information;
viii. draw an appropriate conclusion, justifying it with reference to the data and using an appropriate explanation;
ix. identify sources of error and suggest possible improvements in procedures;
x. plan an experiment or investigation, including making reasoned predictions of expected results and suggesting suitable apparatus and techniques;
xi. recognise, observe, record and measure images of familiar, and unfamiliar, biological specimens.

According to Abrahams and Reiss (2012), their study explored possible ways of assessing practical work in school Science and they discovered two assessment strategies:

i. *Direct assessment of practical skills* (DAPS) that refer to any form of assessment that requires learners to demonstrate directly and physically specific skills; to determine their levels of competency. Abrahams and Reiss (2012) gave an example of this assessment: learners being asked to use a measuring tape.

ii. *Indirect assessment of practical skills* (IAPS), which refers to any form of assessment where learners' competency level is indirectly inferred from information that learners provide e. g when a teacher assesses a learner's planning skills.

Abrahams and Reiss (2012) concluded in their study that both assessment methods have a part to play in an effective assessment of school Science, although indirect assessment of practical skills may constitute a less valid assessment. They add that assessment is essential in science subjects because it drives the results of teaching and to an extent helps teachers choose different types of practical work when considering what the curriculum entails. Abrahams & Reiss (2012) elaborated it is necessary for teachers to know exactly what they should assess, and that they should have a thorough conceptual understanding of substance in order to assess effectively.

Bennett and Kennedy (2001) claim that an out-dated model of assessment was being used to assess learners' practical skills and abilities in set examinations. Toplis and Allen (2012) postulated that schools in the UK had shifted their focus from assessing learners' practical skills and skill at handling apparatus; and concentrated on the knowledge of Science and the understanding of substantive concepts. Abrahams and Reiss (2012) concluded that schools are pressured to assess in order to help teachers focus on the actual development of practical skills that could be useful to learners in their future studies.

2.13 Types of practical activities

Millar (2012) described practical work as any type of Science teaching and action in which learners, working either independently or in small groups, are involved in controlling and/or observing real objects and materials (e.g. determining which of a selection of objects are magnetic; carrying out and observing flame tests). There are various kinds of practical work,

depending on what these practical activities require learners to do and what teachers intend to teach learners (Millar, 2012).

Roberts (2004) mentions using varying practical work within a problem-solving model in Science. He noted that it is important to arrange practical activities in order for the learner to achieve problem-solving solutions. Roberts (2004) outlined the following as the activities that Science practicals could focus on: demonstrations, class experiments, a series of activities, simulations and role plays as well as investigations and problem-solving.

The main purpose of practical work is to help learners to connect two domains: the domain of objects and observables and the domain of ideas (Millar, 2012). According to Millar (2012) the practical activities done by learners may differ as they focus on two different domains. However, he agrees that the domain of ideas plays a minor role when compared to the domain of objects and observables. The domain of objects and observables allows learners to observe, which in turn requires them to remember what they have observed. The domain of ideas requires learners to develop an understanding of distinctive scientific ideas, thereby boosting their understanding of what they are learning about. Millar (2012) noted further that learners learn when the exercises require them to utilize their hands as well as their minds, meaning that when assessing the effectiveness of exercises, both domains should be utilised.

According to Millar (2012) in doing these activities, learners may require assistance in the correct procedure and to develop sensible ideas for the tasks which will later help them learn. He claims that activities which have this scaffolding built into their designs are also more likely to be effective than those that do not have this built into their designs (Etiubon and Udoh, 2017).

Brown (1995) and Woolnough (1994) stipulated that practical work is held together by the following activities:

i. Hands-on experiments;
ii. Observations;
iii. Demonstrations;
iv. Group discussions;

v. Pencil and pen exercises; and

vi. Projects.

The authors explain that these activities include investigative work that is guided by inquiry. Similarly, Roberts (2004) outlines practical skill, technological tasks, observation tasks as well as investigations and exploratory tasks as the main practical activities for his focus.

2.13.1 Practical skills

Roberts (2004) stated that the practical activities commonly used by teachers allow learners to achieve scientific skills. He adds that these skills can be as simple as teaching a learner how to read a thermometer or even how to heat up a test-tube. When a learner acquires the basic skills, it becomes easy for a teacher to ask learners to do simple practical activities such as preparing and staining a microscope slide. Staining a microscope slide can be taught. Roberts (2004) concluded that since the activities require practice, they are classified as skills.

2.13.2 Technological tasks

According to Roberts (2004), some of the practical activities require logical reasoning and recall of substantive ideas. These may be as light as asking a learner to identify faulty components in an electric circuit or as complex as designing electronic solutions or asking learners to identify a chemical through numerous tests (Roberts, 2004). He further explained that technological tasks are known for requiring the recall of skills and procedures as well as applying concepts to new contexts.

2.13.3 Observation tasks

These are tasks that require one to be observant. At school level, these tasks mostly require the learner to recall ideas and basic skills and demonstrate a practical. Roberts (2004) stated that observation is more than just seeing. He goes on to point out that observational tasks could be used to show how experimental science requires one to be careful, considering that one has to be observant when viewing real content.

2.13.4 Investigation and exploratory tasks

These are identified as practical tasks which consider a problem for which there is no easily recalled solution (Roberts, 2004). He noted that there is a difference in practice between the investigation and the exploratory task. He said that according to curriculum contexts, an *investigation* is defined as a problem that is restricted to considering relationships between variables, and such tasks are known to be relatively short and focused tasks that can be completed within a short period of time. On the other hand, exploratory tasks are known to be open-ended and have no room for solutions that can be recalled effortlessly. They investigate expanded issues and they are not limited to connections between two factors as is the case with the restrictions inherent to investigatory tasks (Roberts, 2004).

2.14 Scientific enquiry

Due to the fact that people have various perceptions of science, *scientific enquiry* is defined differently by different people. Bybee (2000) refers to inquiry as "methods and processes that scientists use during scientific inquiry" (p.37). In addition to this, he argues that inquiry should be used by learners to solve problems using their cognitive abilities. Teachers can, moreover, utilize inquiry as a methodology to direct the learning of scientific inquiry. According to Bybee (2000), scientific inquiry can be used to improve one's level of understanding of scientific concepts and principles further.

However, Wheeler (2000) describes *scientific enquiry* as a stretchable word, by which he means that it has plenty of meanings drawn from different people's perceptions. He outlines three types of scientific enquiry activities, as follows:

i. Inquiry: engaging learners in hands-on activities. Not all hands-on activities are inquiry-based and meaningful learning is not guaranteed.
ii. Inquiry: engaging learners with materials by doing experiments. Activities involved in experimentation are observing, asking questions, making inferences or predictions and thinking about how to process the results from experiments.

iii. Engaging learners in the process of inquiry, that is, inquiry becomes the content to be taught (Wheeler, 2000).

Keys and Kennedy (1999) define *scientific inquiry* as "the activities of learners in which they develop knowledge and understanding of scientific ideas as well as understanding how scientists study the natural world" (p.315). The authors add that with scientific inquiry there is usually a focus on what learners already know and their engagement with the physical, social, cultural and technological environment. According to Keys and Kennedy (1999), inquiry science is multi-faceted and it revolves around perceptions, inquiring questions, examining books and other sources while searching for data to see what precisely is already known and what is not. It includes arranging examinations and going through what is known within the line of experimental evidence by utilizing devices to gather, examine and translate information. Keys and Kennedy (1999) claim that their definition of scientific inquiry may be too broad for teachers to consolidate. Teachers find it difficult to transform these scientific inquiry skills into actual activities to help teach learners and therefore they need detailed help to achieve this.

Bybee (2000) believes that science content can be taught through inquiry as a teaching technique due to the fact that science is understood through inquiry. Therefore, learners studying sciences ought to focus on science essentials by doing activities such as tests and practical work. However, practical work is difficult to carry out, therefore there is a need for teachers to undergo training, in order for them to be exposed to the essential skills required for teaching practical work (Hodson, 1996). Science investigation can be carried out in classrooms for practice in three ways, namely: investigation activities may be added on as a whole separate class exercise; they may be added on through pre-writing investigative activities that form part of a normal class; or investigation problems may be investigated as they arise in an informal way from learners (Hodson, 1996).

Kandjeo-Marenga (2008) identified six different kinds of investigations, discovered by Watson, Goldworthy and Wood-Robinson in 1999, who had conducted a study about science investigations, namely:

i. Classifying and identifying.

ii. Fair testing.
iii. Pattern-seeking.
iv. Investigating models.
v. Exploring.
vi. Making things or developing systems (p.102).

2.15 Chapter summary

Chapter 2 presented different perspectives on teaching and learning in relation to practical work done in secondary schools. The origin and social context of Biology was discussed as well as the strengths and weaknesses of Biology as a subject and their influence on the teaching and learning of practical work.

The next chapter will discuss the methodology, the procedures of data collection and the analysis of this study.

3 Research Methodology

3.1 Introduction

The aim of this study is to assess the views and attitudes of Biology teachers towards practical work in the Khomas region. To achieve this aim, it is vital to decide on the type of research methodology to be used in order to accomplish an accurate assessment. A research methodology is a philosophical framework that guides the activities of the research. This chapter will briefly describe the research methods that were used to collect and analyse the data obtained from the participants.

3.2 Research design and procedures

This study aims to explore the views and attitudes of Biology teachers towards practical work and how these two aspects affect the learning processes and performance of learners. Therefore, it was of great importance for the researcher to choose and use the right research design, which would allow her to collect the information for the set research problem.

3.2.1 Research design

Creswell and Clark (2007) regard a research design as the philosophical assumptions of the study framework which are linked to the methods to be used in conducting the study. The research design is known to play a role in an investigative or assessment study for an obvious reason: it provides an outline of the route that will be followed in order to conduct the study Creswell and Clark (2007). Evidence obtained through a research study allows the researcher to answer the research questions as comprehensively as possible and the platform to do so is created by the research design.

The research design of this study is characterized by both qualitative and quantitative designs. Creswell (2012) explains that in quantitative research, the assessor distinguishes an issue for investigation based on the field or the need to be clarified and why the issue is considered worthy of investigation. The researcher therefore seeks responses from respondents and notes the differences in respondents' responses. He/she notes further that a researcher must explain

how variables affect each other. Variables can be attributes, e.g attitudes or characteristics of individuals, which are studied by a researcher. Creswell (2012) states that by explaining and describing a relationship among variables, a researcher determines whether one or more variables could possibly influence other variables.

This study aims to assess Biology teachers' views and attitudes towards practical work in the Khomas region of Namibia. In the section of the study dealing with the research design, the researcher aims to answer the research question; to incorporate the views from international scholars and outline procedures of inquiry and specific strategies of data collection, analysis and interpretation (Creswell, 2003).

3.2.2 Survey design

Issac and Michael (1997) define a *survey* as research that is utilized to provide answers to questions addressed, to clarify issues that have been posed, to assess needs and set goals, to choose whether or not specific objectives have been met, to set up baselines against which future comparisons can be made and to dissect patterns over time. Survey research is used to describe aspects, which generally includes examining the connections among factors of a given population on a quantitative premise (Glasow, 2005). He further urges that survey research is collected from people, more specifically, from a selected population.

Furthermore, according to Issac and Michael (1997) a survey research design is used

> To answer questions that have been raised, to solve problems that have been posed or observed, to assess needs and set goals, to determine whether or not specific objectives have been met, to establish baselines against which future comparisons can be made, to analyse trends across time, and generally, to describe what exists, in what amount, and in what context (Issac and Michael, 1997, p.136).

The authors stress that survey research is utilized to describe characteristics, which mostly involve examining the connections among factors of a given population on a quantitative premise. Surveys are carried out with individuals of a chosen population from which the outcomes can later be generalized back to the population (Creswell, 2012). In survey research,

the scope of the study is defined by the independent and dependent variables. Creswell (2012) adds that a survey is constructed to test a predicated model against observations of phenomena. The researcher is required to predicate a model that recognizes the anticipated connections among factors some time prior to conducting the survey.

3.2.2.1 Survey research strengths

Surveys are known to be well-suited to gathering statistical data that portray the composition of the information and data can be obtained from broad samples of the population by utilizing this method (McIntyre, 1999). “Surveys are inclusive in the types and number of variables that can be studied, require minimal investment to develop and administer, and are relatively easy for making generalizations”(Bell, 1996, p.68).

3.2.2.2 Weaknesses of survey research

According to Bell (1996), certain problems may arise during a survey research, which may affect the responses given by the respondents, which may, in turn, reduce the accuracy of the responses. He included that there may be other errors which will influence the survey outcomes, such as deliberately overstating respondents’ responses.

Levy and Lemeshow (1999) identified two steps in the survey design. They are as follows:

i. A sampling plan — which is defined as a methodology that is used to select the sample from the broader population. The plan describes how the sample is selected, how an adequate sample size will be determined, and the media through which the survey will be administered. The media may include telephonic and face-to-face interviews, as well as electronic mails (Salant and Dillman, 1994).
ii. Procedures for obtaining population — a study population is selected from testing data and from assessing the quality of the population estimates. By doing this, the desired response rate and preferred level of precision for the survey are distinguished (Salant and Dillman, 1994).

3.3 Context and sampling

3.3.1 Description of the Khomas region

This study was conducted in thirty selected secondary schools offering Biology as a subject in the Khomas region. Namibia has fourteen regions of which Khomas is one. The region's name refers to the Khomas Highland, a high plateau landscape that dominates the administrative unit. The Khomas region is centred on the capital city of Namibia, known as Windhoek, and for this reason it is known to provide a superior transportation infrastructure to other parts of Namibia. It is located in the central highlands of the country and is bordered by the Erongo region to the west and northwest and by the Otjozondjupa region to the north. To the east is the Omaheke region, while to the south is the Hardap region. The Khomas region is characterized by its hilly country and many valleys. It is well-developed with economic, financial, as well as trade sectors. It comprises 4.5 % of Namibia but has the highest population compared to the other thirteen regions. The Khomas region is one of the three regions that do not have a shoreline or a foreign border.

3.3.2 Position of the Khomas region on the Namibian map

Figure 3.3.1 below shows the Namibian map, indicating the regions found in it, with the highlighted (Khomas) region where the study was conducted.

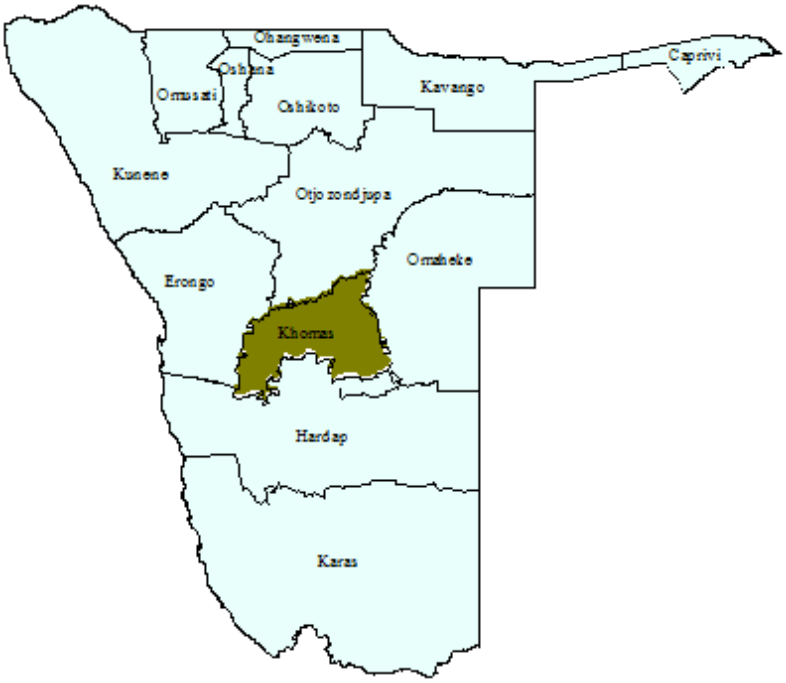


Figure 3.3.1 The location of the study region in Namibia

3.3.3 Geographical location of the schools

Namibia comprises fourteen regions, which include the Khomas region where this study was conducted. The Khomas region is situated in the centre of the country. The present researcher was fortunate enough to have taught Biology at one of the schools in the Khomas region and is familiar with how schools in the region operate. This is the reason for her choice of the Khomas region. Moreover, the researcher considered the fact that she is quite familiar with the region, and would not find locating the schools difficult when data collection started. Seeing that the research is based on Biology teachers' attitudes and views towards practical work in the region, the researcher herself may have experienced challenges during her time of teaching in the region and may have concluded that the challenges might have an effect on the attitudes and views of Biology teachers towards practical work.

3.3.4 Location of the secondary schools on the Khomas region map

Figure 3.3.2 below shows the Khomas region map, indicating locations of the schools where the study was conducted.

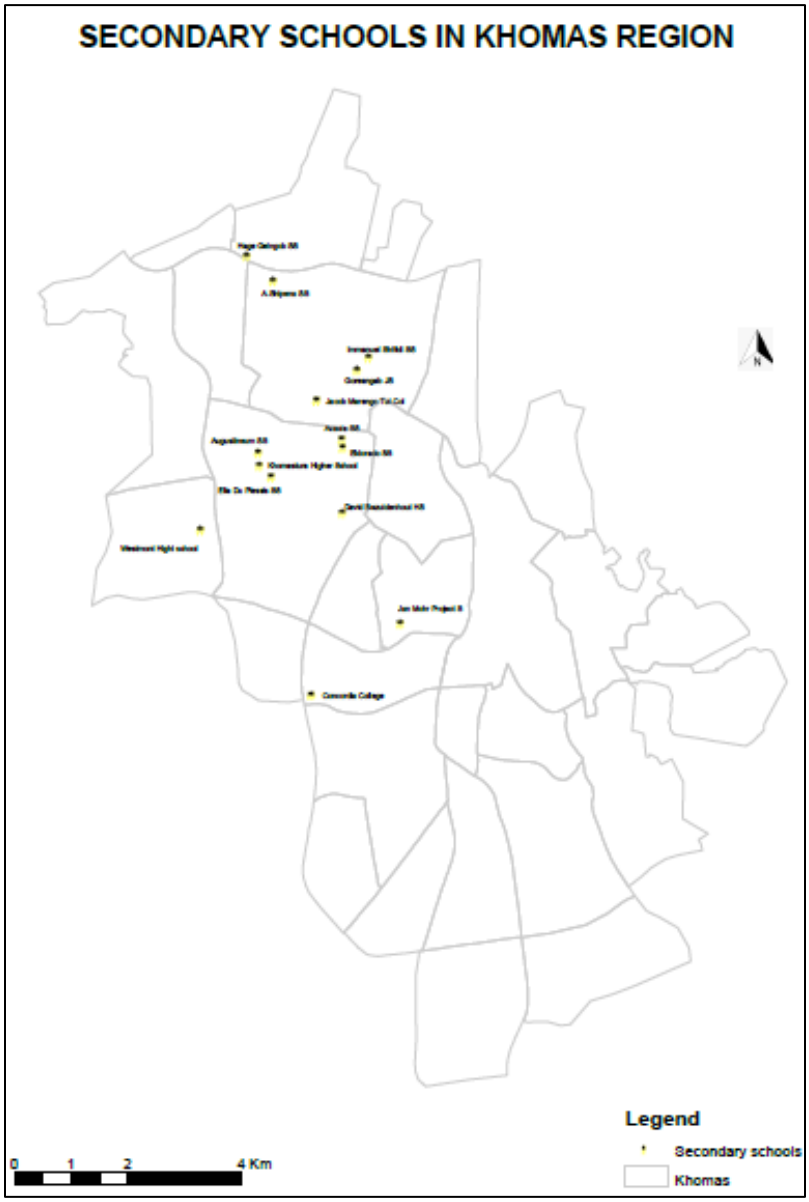


Figure 3.3.2 The Khomas region

3.4 Research sites and data collection process

Before the researcher started with data collection, she studied the map of the city and located most schools. After doing this, the researcher called the schools to make an appointment with the principals whilst explaining the reason for the appointment. Then on the dates set and agreed, the researcher drove to the targeted schools, using the GPS to help locate the schools that she was not familiar with. This facilitated finding the schools. During the visits, the researcher scheduled enough time to talk to the Biology teachers and thoroughly explained the questionnaire. She also scheduled time to talk to the principals before handing out the questionnaires. Each principal first had to grant permission to the researcher and provide her with written permission as requested by the Ethical Clearance Committee of the Stellenbosch University.

During visits, respondents were well-informed about the study details. They were also given an outline of the ethical principles which had been put in place to assure confidentiality. This was done to reassure the respondents, and prepare them for what they would expect in the questionnaires that they were to receive. The researcher sat with the three selected Biology teachers at all the schools where permission had been granted and explained the questionnaire to them. Before handing out the questionnaires, the researcher handed out the letter of consent to the respondents and collected them; then proceeded with the handing out of the questionnaires and gave them a chance to read through the questionnaire and ask questions if the need arose.

The questionnaire was constructed with a view to ensuring the quality of the data collected. The in-depth phenomenological questionnaire allowed the respondents to freely put on paper how they, as Biology teachers, view the practical work. This would give an insight into their views of and attitudes towards practical work. During the time of explaining the questionnaire components, the researcher listened very attentively to the teachers' concerns and questions in order to guarantee that the respondents understood the questions and to avoid misunderstandings of questions which could easily lead to respondents answering questions the wrong way. During this time, the researcher incorporated body language techniques such

as nodding, smiling in response to signify agreement with what the respondents had said or questioned. The researcher made sure that she left the respondents without unanswered questions.

At the end of these sessions, at every school the researcher gave thanks to the respondents for taking time to interact and asked them if they had anything to add or to say about the study. This was done in case there was information which had been omitted or information they might have wanted to share regarding the study which in turn could lead to discovering new information. The researcher allowed respondents two to three days in order to complete the questionnaire. They were asked to submit the completed questionnaires to their school secretary or principal in order to allow the researcher easy access to collecting them, since it could have been difficult to locate the teachers individually for collection of the questionnaires. To enhance validity, when the researcher picked up the questionnaires from the schools, she first read through the questionnaires to make sure the questions were all answered. This became a challenge as it was difficult to trace questionnaires back to the participants at different schools.

3.5 Sampling

Purposeful sampling was carried out in order to select the specific target group of teachers who would participate in the study. This was needed because of the researcher's interest in the information she would collect from participants in the study. In the same vein, Bless and Higson-Smith (2000) noted that quality information and an overview of many participants is gathered through the process of sampling. Therefore, to select the schools for the present research, the researcher used a site selection approach, which helped locate the schools offering Biology at secondary school level. The sample comprised three Biology teachers from thirty secondary schools, since the research aims to generalize the findings to a larger population to enable them to understand the views and attitudes of Biology teachers towards practical work in all secondary schools offering Biology in the Khomas region.

The three Biology teachers per school were selected based on the following:

i. The teachers taught Grades 9 and 11 using the newly established curriculum;
ii. The schools offered Life Science/Biology for Grades 8-12;
iii. The willingness of Biology teachers to participate in the study.

3.6 Pilot study

The questionnaire was piloted with twenty Grade 8 and 10 teachers in senior secondary schools in the Khomas educational region. These teachers helped determine whether the questionnaire would produce the anticipated results. They clarified whether the questions were ambiguous or not clear and the instrument was refined accordingly. A Cronbach alpha coefficient was computed to determine the internal consistency of the items forming part of the instruments.

3.7 Data collection instruments

3.7.1 Questionnaire

The research instrument used was a two-part questionnaire: an attitudinal scale and a rank-order scale were supplemented by three qualitative questions at the end.

The first instrument used was a Likert scale. It is used to represent people's attitudes towards certain practical work situations. This scale was developed by Rensis Likert (1967) to measure attitudes. Likert (1967) alludes to the fact that certain criteria should be kept in mind when collecting and structuring statements for the survey questionnaire. According to Likert (1967) the statements should be of such a nature that persons with different points of view and attitudes are accommodated. In this survey research, the researcher measured the attitudes of Biology teachers in the Khomas region of Namibia using a 5-point Likert scale. The researcher developed eleven statements which were set to measure the attitudes of teachers towards practical work. These statements were considered as they were seen to have the potential to identify the attitude of teachers towards practical work. They were developed based on the researcher's understanding as a former Biology teacher. Each item was based on situations that Biology teachers encounter and so the research ought to test what teachers feel about the situations in order to reflect their attitudes. For every item on the scale, the respondents were

expected to indicate whether they 1= *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 *agree*, 5 = *strongly agree*. This was to determine if they had a positive or negative attitude towards Biology practical work.

Secondly, a rank-order scale was used, which may be a survey that permits respondents to arrange and rank different options in a particular order. The respondents were asked to rank ten (10) given items in their order of priority. The items related to the aims/purposes of practical work for Biology as a subject in Grades 9 and 11. Thirdly, on the same questionnaire, three open-ended questions were included at the end, which asked respondents why they had ranked the top 3 aims as more important, why they had ranked the last three as the least important and lastly what their concerns were about the aims of practical work. This was to clarify their motivation behind their decisions for the specific rankings that they had given.

3.8 Data processing and analysis

Data analysis includes organizing, taking account for, and clarifying the data; in brief, making sense of data in terms of participants' definition of the circumstance, taking note of patterns, themes, categories and regularities (Cohen, Lawrence and Keith, 2006). Statistical analysis was used to analyse the data that had been collected. Statistical analysis involved the collecting and scrutinizing of every piece of data collected from a study in which samples had been drawn. Reliability of the attitude items was tested by calculating Cronbach's alpha > 0.5 indicating acceptable reliability.

Summary statistics were reported as frequencies and percentages for categorical data, means and standard deviations, 25th and 75th percentiles. Cronbach's alpha was used to investigate reliability of the attitude construct. One-way Analysis of variance (ANOVA) was used to investigate gender differences for attitude and the importance rankings. The importance rankings were compared using mixed model ANOVA. Normality assumptions were checked from normal probability plots, and found to be acceptable.

3.9 Validity and reliability of the study

3.9.1 Validity

According to Cohen, Lawrence and Keith (2006) a quantitative research instrument can be used to measure the extent to which instruments are valid and reliable, i.e. measuring validity and reliability. A valid instrument is one that does what it is intended to do (De Vos, Fouche and Strydom, 2005); that measures what it is expected to measure and yields scores whose differences reflect the genuine contrasts of the variable being measured rather than random scores (De Vos, Fouche and Strydom, 2005). Therefore, to ensure validity of the instruments used in this study, the questionnaire was given to a panel of officials in the Department of Curriculum Studies, who assisted in determining the content validity of this study and its instruments.

3.9.2 Reliability

In quantitative research, reliability alludes to the degree to which research findings could be duplicated if the study were to be repeated, with the aim of creating cause and impact relationship among factors (Creswell, 2012). Reliability is fundamentally not concerned with what is being measured, but with how well it is being measured. Cohen, Lawrence and Keith (2006) report that reliability in quantitative analysis has two main forms, aims which are to measure the internal consistency: the split-half technique and the alpha coefficient. Both calculate a coefficient of reliability that can lie between 0 and 1. In this study, the Cronbach Alpha coefficient was calculated to determine the internal consistency of the Likert scale and the standardized Cronbach Alpha coefficient was = 0.74. The questionnaire was also given to the supervisor in order to help make changes and correct for the final instrument.

3.10 Ethical considerations

Ethics refer to the code of conduct which will secure an individual's privacy. Generally, the code of conduct aims to protect people's characters and whereabouts. Survey researchers have constrained direct individual contact with their subjects, from where most of the moral issues

may surface (Christians, 2000). It is for this reason that the research proposal of this study was submitted to the Research Ethics Committee (Human Research) at the Stellenbosch University. The letter that confirmed ethical clearance by Stellenbosch University is found in Appendix B. In addition, a letter was written to the Namibian Ministry of Education, Arts and Culture, as well as to the office of the Khomas Regional Council Directorate of Education, Arts and Culture for permission to conduct the research study. Permission from the Ministry is found in Appendix C and permission from the Khomas Director is found in Appendix D. The questionnaires were only handed out to participants after they had signed the consent form. Participants were informed about the terms of the questionnaire and made to understand that they were free to stop participating at any point if they felt uncomfortable. The respondents' information was treated with confidentiality.

3.11 Chapter summary

In this chapter, the research methodology was discussed, including specific research strategies that were used in collecting qualitative and quantitative data. In Chapter 4, the results obtained from the data collected from the respondents' answers to the research questionnaire will be presented and discussed.

4 Results and Discussion

4.1 Introduction

In the previous chapter, the various study methods applied in the study were discussed. The researcher identified data analysis strategies as well as methods used in indicating reliability and the ethical procedures used in the study. This chapter presents and discusses the findings of data collected. This study aimed to assess the views and attitudes of Biology teachers in the Khomas region of Namibia. Questionnaires were administered to selected Biology Grade 9 and 11 teachers and therefore, the findings are discussed.

The previous chapter gave a clear description that the researcher planned to visit secondary schools in the Khomas region, Namibia in order to hand out the questionnaires to Grades 9 to 11 Biology teachers (two to three teachers from each selected school). The researcher visited the schools accordingly. However, some of the school principals refused to give permission to the researcher to conduct the study because their teachers were seemingly busy with learners and other work responsibilities. A few teachers refused to take part in the study, claiming to be busy with their own studies and others were busy with marking, invigilating examinations and doing administration work. Some schools were classified as *private schools* by the Ministry of Education Arts and Culture, meaning the ministry could not grant the researcher permission to conduct the study at these schools. For these reasons, the researcher was limited to carrying out the study at only 14 schools with only 46 Biology teachers participating in the study. As per ethical requirements, the names of the schools, teachers and identities of respondents in this study have not been revealed, in order to protect their identities.

4.2 Presentation of Quantitative data

The presentation of quantitative data is based on the responses given by the respondents to whom the 5-point Likert scale and rank-order scale were administered.

4.2.1 Analysis of questionnaire

A total of 50 questionnaires were distributed to the Biology teachers of the schools which had granted the researcher permission to conduct the study. A total of 46 questionnaires were

completed. Only 44 of the 46 respondents indicated the grades they teach, of which 27 respondents taught Grade 11 and 17 respondents taught Grade 9.

The questionnaire was divided into two sections. The first section comprised a 5-point Likert scale, which aimed to establish the difference between female and male teachers' attitudes towards practical work as well as the difference between experienced and less experienced teachers' attitudes towards Biology practical work. The second section sought to identify the practical aims that were most highly ranked (top three positions) and those ranked lowest (bottom three positions), and to establish what the differences between female and male teachers were as well as between experienced and less experienced teachers in ranking the items. Gender differences and teaching experience within the sample were therefore analysed.

The researcher formulated the items included in the two scales in relation to the main research questions, after they had been thoroughly scrutinized by the study leader. After the items had been scrutinized and revised, the final questionnaire was compiled and was ready for distribution.

4.3 Data presentation and discussion

The data are presented and discussed in three categories, namely (1) the respondents' demographics information; (2) the respondents' attitudes towards practical work; (3) the respondents' views of practical work. This is done according to the questions in the order of alignment in the questionnaire. Data from the questionnaire is presented in graph form and table form which shows the respondents' level of agreement as was indicated using a 5-point Likert scale with *strongly agree*, *agree, neutral, disagree* and *strongly disagree*. In a similar vein data from the rank-order scale, which shows the order of importance of practical aims as ranked by the respondents, is presented in graph and table format. The data is presented in terms of the four hypotheses that were to be tested in what follows below.

4.3.1 Respondents' demographic information

In this sub-section the respondents' demographic information is described. The histograms in this section show the respondents' responses to the biographical section of the questionnaire.

4.3.1.1 Gender

As illustrated in Figure 4.3.1 a total of n= 46 participated in the study. Slightly less than a third 14/46 (30%) of the respondents were male compared to more than two thirds 32/46 (70%) of the respondents who were female.

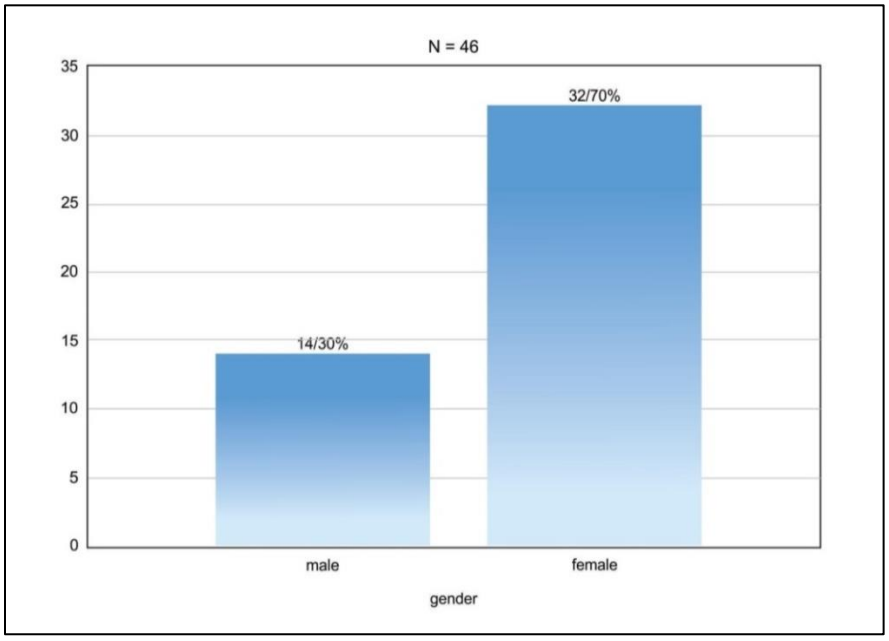


Figure 4.3.1 Respondents' gender

4.3.1.2 Qualifications

Figure 4.3.2 shows the analysis of the respondents' qualifications. It was observed that 22 (48%) of the respondents indicated that they were in possession of Honours degree qualifications; 18 (40%) indicated that their highest qualification was a three-year Bachelor's degree; 3 (7%) of respondents were in possession of Bachelor's degrees and a diploma; and only 2 (4%) indicated that they held Master's degree qualifications.

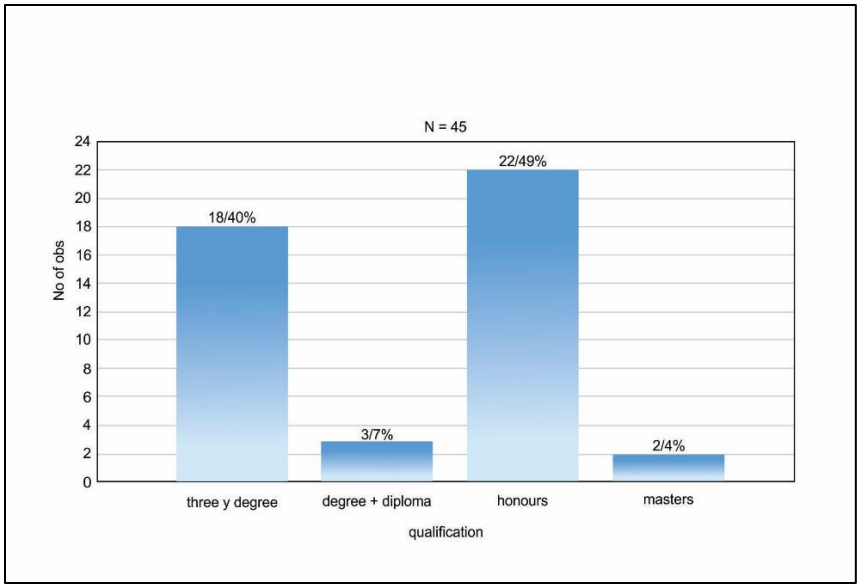


Figure 4.3.2 Qualifications obtained by respondents

4.3.1.3 Grades that respondents indicated to have taught

Figure 4.3.3 shows the analysis of the grades taught by the respondents. It was observed that a total of 44 respondents indicated which grades they taught. It was observed that 27 (61%) of the respondents indicated that they taught Grade 9 and 17 (39%) of the respondents indicated that they taught Grade 11.

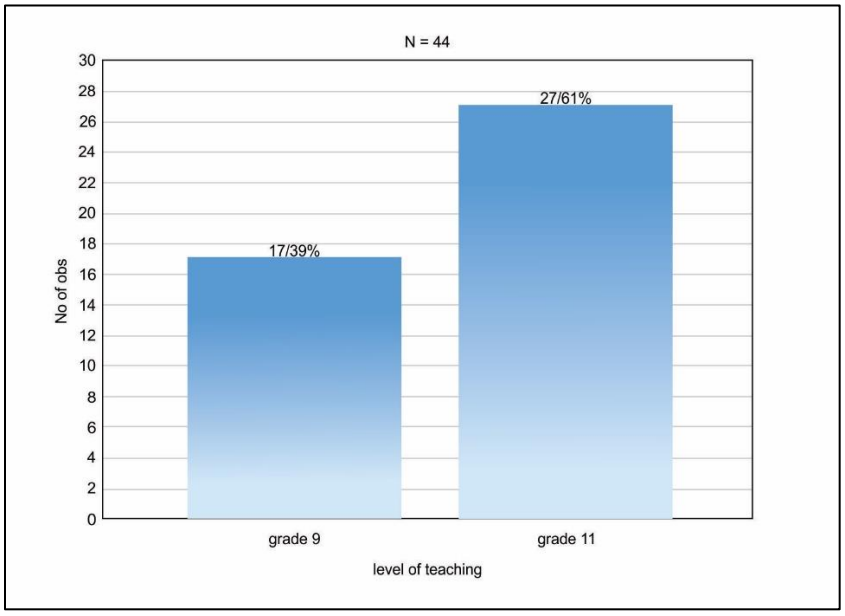


Figure 4.3.3 Grades taught by respondents

4.3.1.4 Number of years' teaching

In Figure 4.3.4 below, the respondents' number of years' teaching were analysed. It was observed that the respondent with the most experience had been teaching for twenty (20) years and the respondent with the least experience had one (1) year of teaching experience. Respondents had an average of 6.5 years of teaching experience and the standard deviation for years of teaching experience was 4.6. A total of 4 of the respondents were identified to be grouped in the lower 25th percentile of years' teaching experience compared to 9 respondents in the 75th percentile. Fifty (50%) (22) of the respondents reported between 4 and 9 years' teaching. The figure indicates that the dataset had two outliers with respect to years' teaching experience; respondents with 18 and 20 years respectively. This suggests that the cohort of Biology teachers teaching Biology in the Khomas region of Namibia are young with relatively few years' teaching experience.

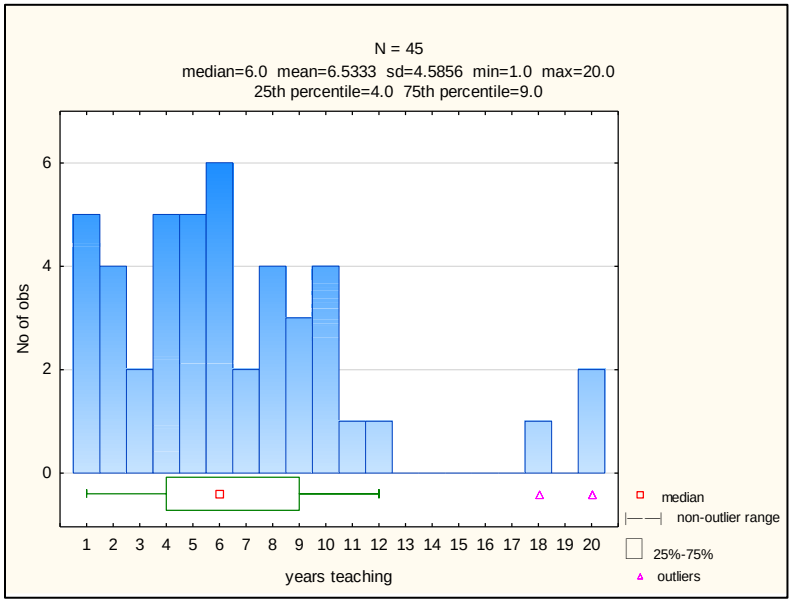


Figure 4.3.4 Respondents' number of years' teaching

4.3.1.5 Average numbers of learners in class

The highest number of learners in a class ranged from 15 to 65. The average number of learners per class was 37 with the standard deviation of 7. A total of 32 respondents were identified to be grouped in the lower 25th percentile of the average number of learners in a class while 42 respondents were grouped in the 75th percentile. Figure 4.3.5 indicates that in this dataset class sizes of between 60 to 65 learners were outliers.

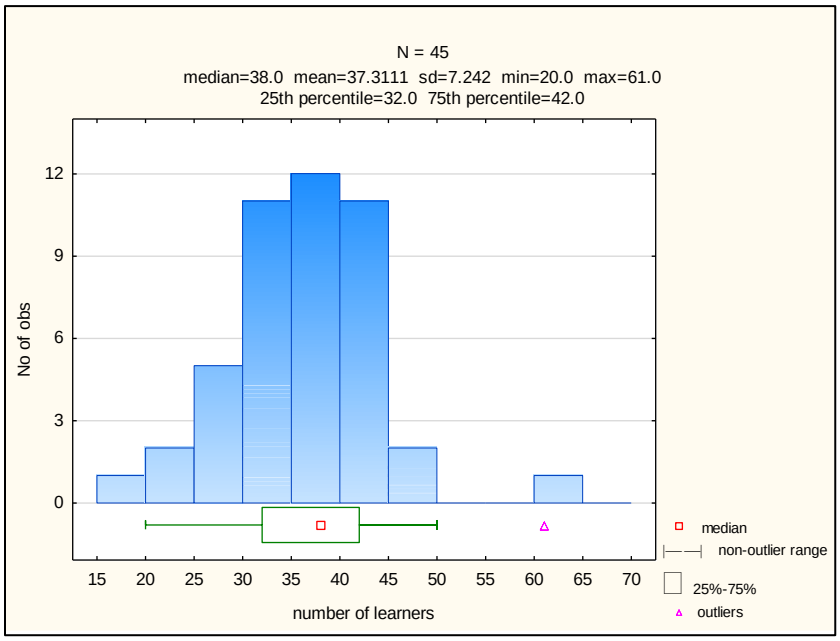


Figure 4.3.5 Average number of learners in a class

4.3.1.6 Age

Figure 4.3.6 shows an analysis of the age groups of respondents. Their ages ranged from 23 to 54. The average age of respondents was 34 years old with a standard deviation of 7. The figure indicates that the highest recorded age group was 30-35 years old with 16 (36%) respondents. A total number of 29 respondents were identified to be grouped in the lower 25th percentile of age compared to 36 respondents identified in the 75th percentile. It was observed that the dataset had two age categories that were outliers, that is, respondents in the age categories of respectively 45-50 and 50-55 years old.

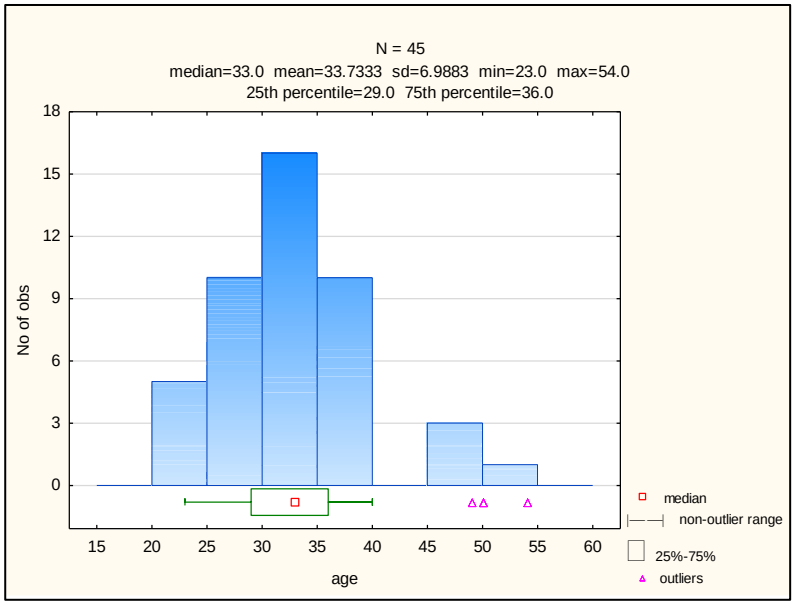


Figure 4.3.6 Respondents' age groups

4.4 Biology teachers' attitudes towards practical work

This sub-section discusses the attitudes of respondents as investigated using a 5-point Likert scale. The histograms in this section show the participants' responses to the eleven statements that required the Biology teachers to indicate their levels of agreement. This analysis was used as a part-indicator of the respondents' attitudes towards Biology practical work in testing hypotheses 1 and 2.

4.4.1 Practical activity needs more time than the time allocated to a period

Figure 4.4.1 indicates that 27 (60%) of the 45 respondents *strongly agreed*, 29% (13) *agreed*, 3 (7%) were *neutral* whilst 2 (4%) of the respondents *strongly disagreed* for item 1.

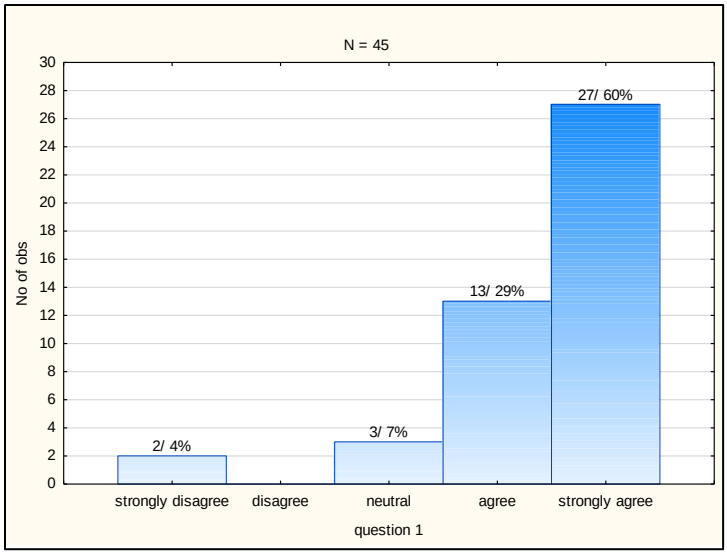


Figure 4.4.1 Responses to item 1 on the Likert scale

4.4.2 Providing support to learners during practical work

Figure 4.4.2 below indicates that 32 (71%) respondents out of the 45 respondents *strongly agreed*, 12 (27%) *agreed*, and only 1(2%) of the respondents indicated *neutral* for item 2.

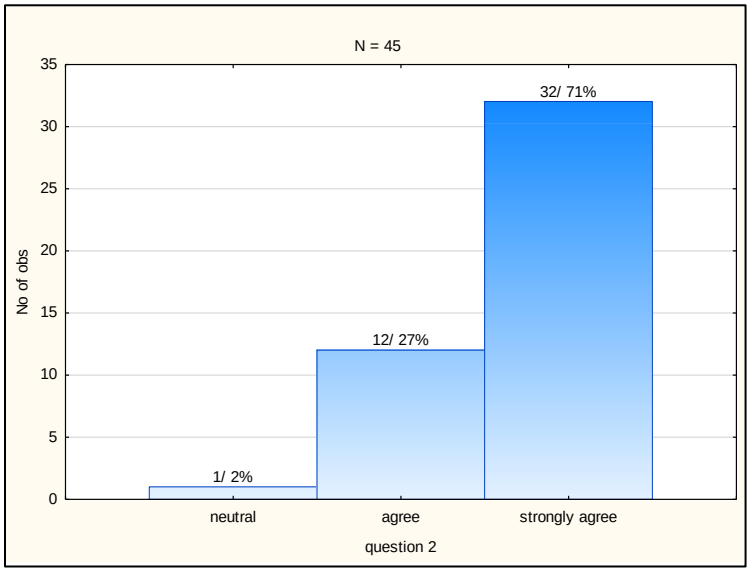


Figure 4.4.2 Responses to item 2 on the Likert scale

4.4.3 Teaching Biology is not fulfilled without practical work

It was observed in Figure 4.4.3 below that 29 (66%) of the 44 respondents had *strongly agreed*, 11 (25%) had *agreed* and only 4 (9%) of them had indicated *neutral* for item 3.

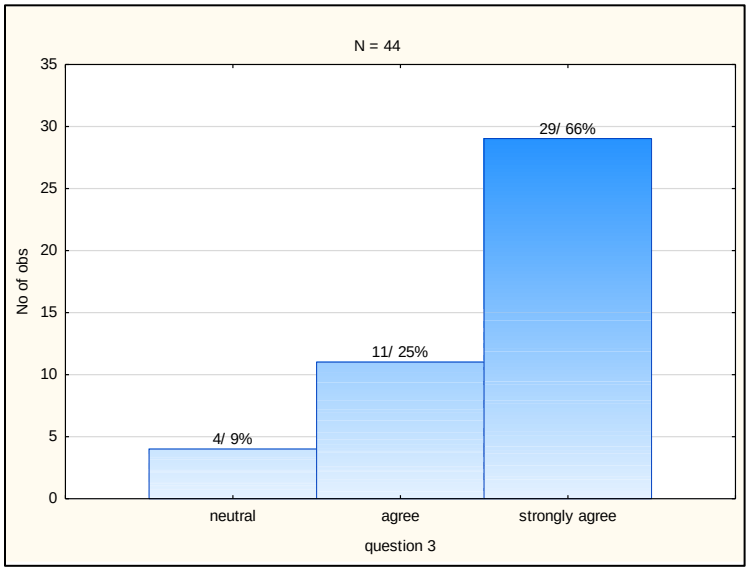


Figure 4.4.3 Responses to item 3 of the Likert scale

4.4.4 Believe in collaborating with other teachers in preparing practical sessions

In Figure 4.4.4 it was observed that 22 (50%) respondents indicated to have *agreed*, 17 (39%) had *strongly agreed*, 4 (9%) were *neutral* and only 1 (2%) respondent had *strongly disagreed* to item 4.

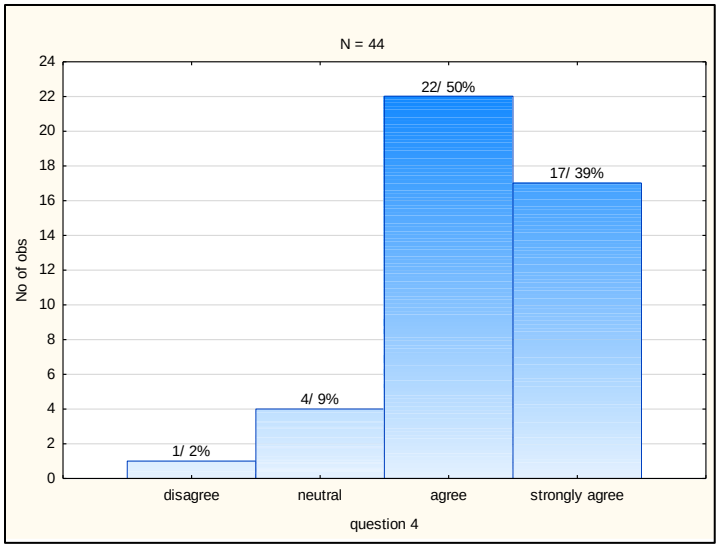


Figure 4.4.4 Responses to item 4 on the Likert scale

4.4.5 Look forward to preparing practical work for learners

It was observed that in Figure 4.4.5 more than half of the respondents 25 (56 %) indicated *strongly agreed*, 18 (40 %) indicated *agreed*, 1 (2 %) was *neutral* as well as 1 (2%) of the respondents had *disagreed* with item 5.

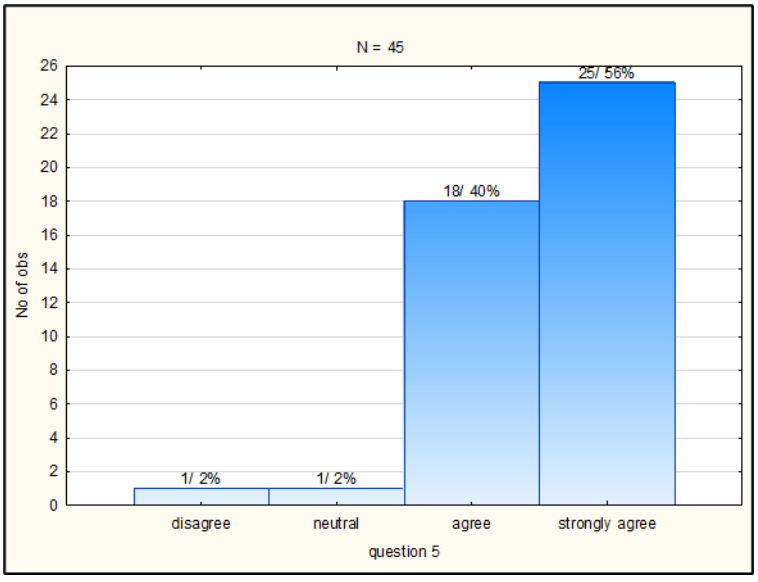


Figure 4.4.5 Responses to item 5 on the Likert scale

4.4.6 Motivated by doing practical work with learners

It was observed that in Figure 4.4.6 below, the majority of the respondents: 35 (78%), had *strongly agreed*, 8 (18%) had *agreed* and only 2 (4%) respondents were *neutral* with respect to item 6.

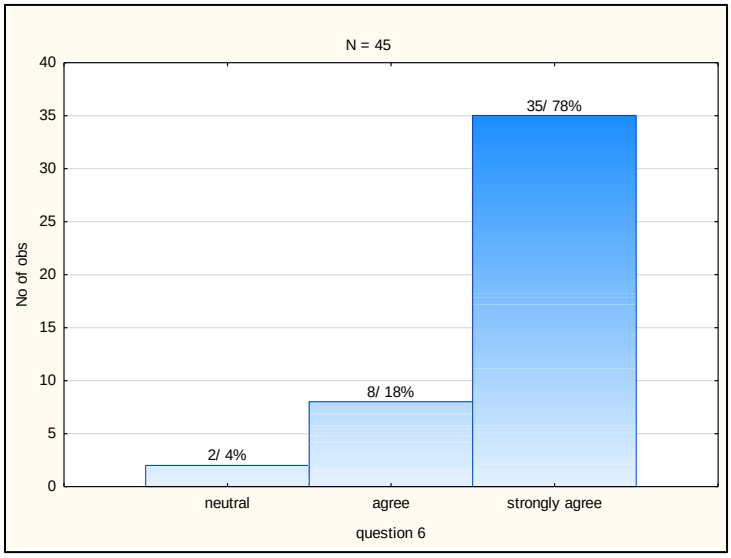


Figure 4.4.6 Responses to item 6 on the Likert scale

4.4.7 Getting meaning as a Biology teacher through engaging with learners in practical work

It was observed in Figure 4.4.7 that more than half 30 (67%) of the respondents indicated *strongly agreed*, 14 (31%) indicated *agreed* and only 1 (2%) respondent indicated *neutral* for item 7.

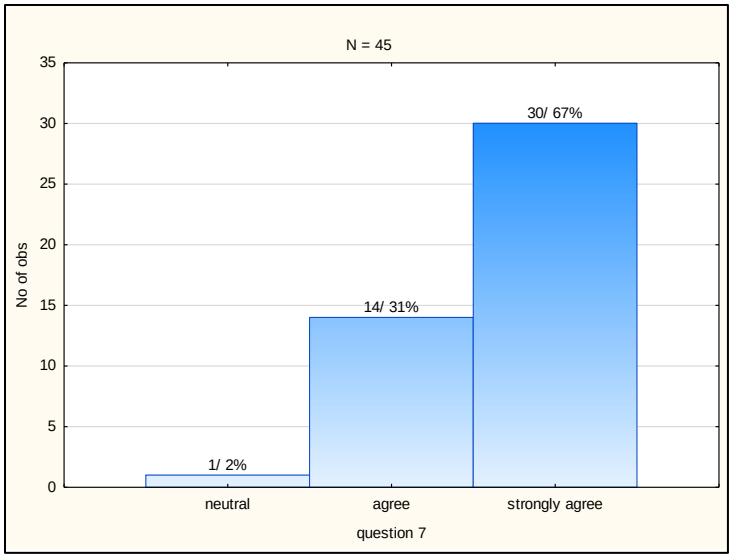


Figure 4.4.7 Responses to item 7 on the Likert scale

4.4.8 It is fun showing learners how to do with biological experiments

In Figure 4.4.8 below it was observed that a higher percentage of respondents 30 (67%) had *strongly agreed*, 11 (24%) had *agreed* and only 4 (9%) respondents indicated *neutral* with respect to item 8.

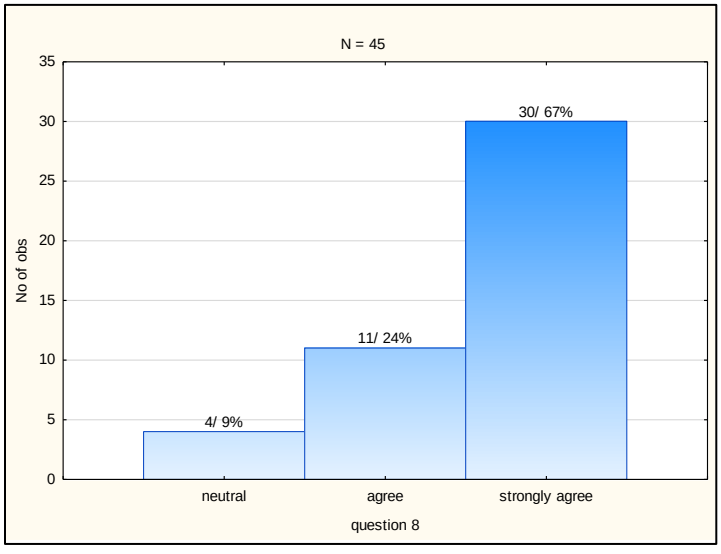


Figure 4.4.8 Responses to item 8 on the Likert scale

4.4.9 Confidence in demonstrating to learners during practical work

It was observed that the majority of respondents 35 (78%) of the 45 respondents had *strongly agreed*, whilst 10 (22%) respondents had *agreed* to item 9 as shown in Figure 4.4.9.

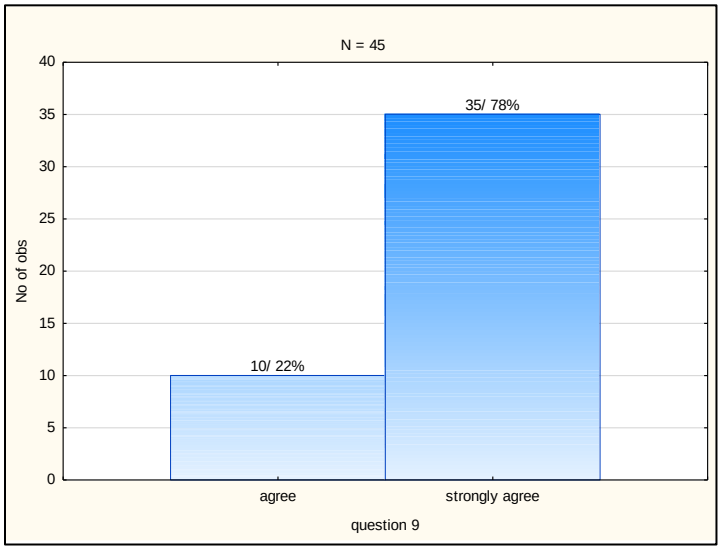


Figure 4.4.9 Responses on item 9 on the Likert scale

4.4.10 Practical examination should be a compulsory component of the Biology examination

It was observed in Figure 4.4.10 below that the majority, 34 (76%) of respondents had *strongly agreed*, 9 (20%) had *agreed*, and only 2 (4%) respondents had indicated *neutral* to item 10.

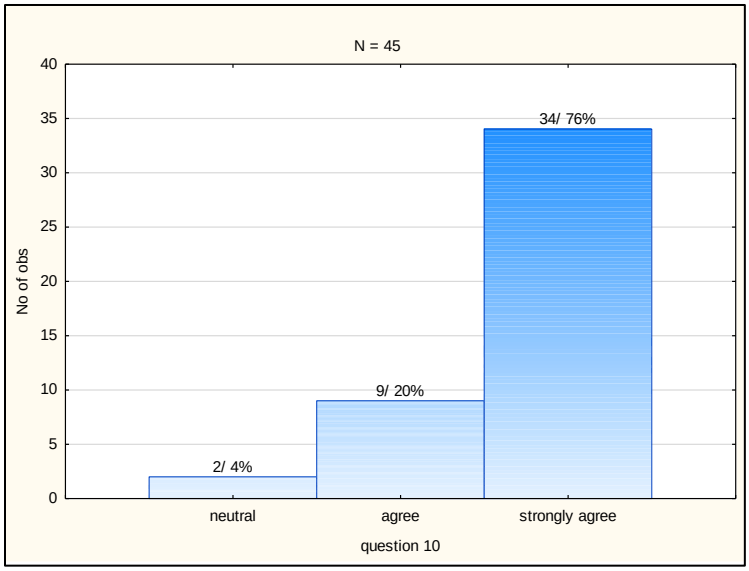


Figure 4.4.10 Responses to item 10 on the Likert scale

4.4.11 Practical work is the most important aspect of Biology as a subject

In the Figure 4.4.11, it was observed that more than half of the respondents 27 (60%) had *strongly agreed*, 14 (31%) had *agreed*, 3 (7%) were *neutral* and only 1 (2%) respondent had *disagreed* with respect to item 11.

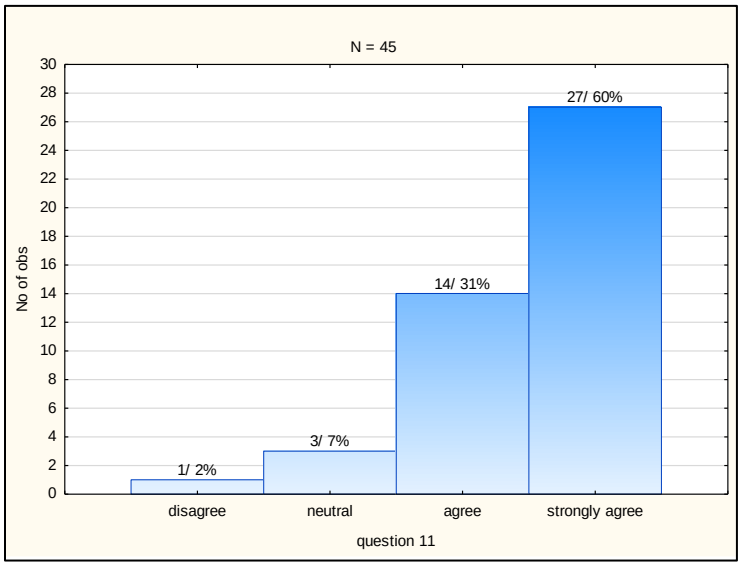


Figure 4.4.11 Responses to item 11 on the Likert scale

4.5 Attitude Hypotheses testing

4.5.1 Distribution of attitude scores

Figure 4.5.1 below shows a distribution of all the attitudinal scores. This shows the average of all the attitudinal items that tested the respondents' attitudes towards Biology practical work. Respondents had an average attitude of 4.57 with a standard deviation of 0.32. A total of 4.36 respondents were identified to be grouped in the lower 25th percentile of age compared to 4.82 respondents in the 75th percentile. A visual inspection of Figure 4-18 indicates that the dataset had an outlier of 3.5 respectively.

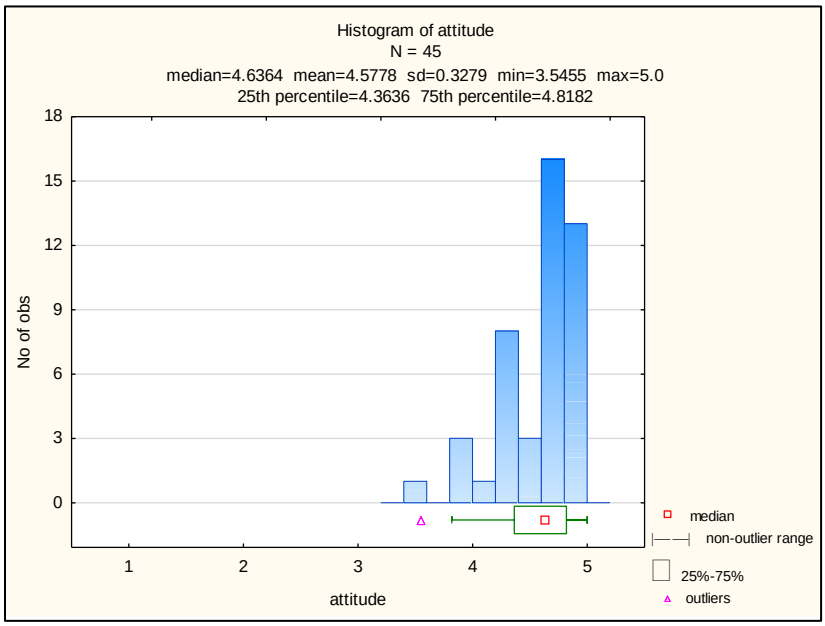


Figure 4.5.1 Distribution of the attitude scores

4.5.2 Null hypothesis 1 (female teachers compared to male teachers in relation to attitude towards practical work)

This sub-section describes the attitudes of respondents' genders as investigated using a 5-point Likert scale. The histogram in this section shows how the two genders responded to the eleven statements that required the Biology teachers to indicate their level of agreement to test the hypotheses 1 and 2.

4.5.2.1 Histogram showing a comparison between female teachers and male teachers in relation to attitude

Hypothesis 1- There are no statistically significant differences between male and female teachers' attitudes towards practical work. A relationship is significant when the p-value is equal to or less than 0.05 ($p < 0.05$). The F- test carried out indicated that no statistically significant relationship ($p = 0.43 > 0.05$) existed between male and female respondents in relation to the attitude they portrayed towards practical work. However, a trend was observed in the analysis showing a higher mean attitude in male teachers (4.62) than in female teachers (4.57) as shown in figure 4.5.2. This could suggest that male teachers find doing practical work slightly more interesting when compared to female teachers. However, this should be tested with much larger samples to see whether the same trend is observed.

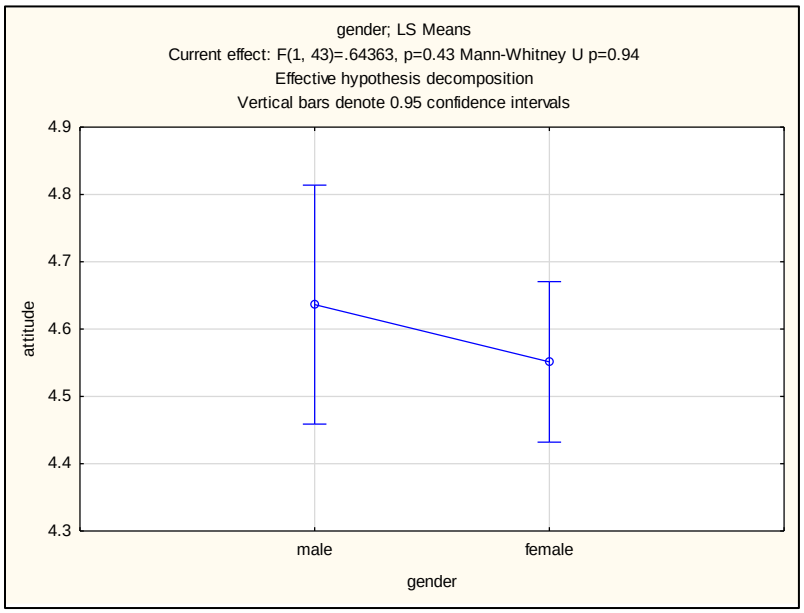


Figure 4.5.2 Gender differences on attitudes towards practical work

4.5.2.2 Descriptive statistics of the relationship between gender and attitude

The relationship between gender and attitude was analysed in a sample size of 45 respondents. The study found an average mean of 4.58 with a standard deviation of 0.33 in the whole sample size. A higher standard deviation was observed in the female respondents (0.37) when compared to male respondents (0.22) as indicated by Table 4.5-1.

Table 4.5-1 Descriptive statistics on attitudes of male and female respondents

Attitude Descriptive Statistics			
Factors	Sample size (N)	Mean	Std. Dev.
Total	45	4.58	0.33
Male	14	4.64	0.22
Female	31	4.55	0.37

4.5.3 Null hypothesis 2 (Respondents' years of teaching in relation to attitude towards practical work)

Hypothesis 2- There are no statistically significant differences between experienced and less experienced teachers and their attitudes towards practical work. No statistically significant relationship (0.34 > 0.05) was identified between the number of years' teaching and the attitude of respondents. However, a positive correlation of 0.15 was observed between the number of years' teaching and the attitude of the respondents. Although the correlation may seem small, respondents scored very high in the Likert scale, showing that both genders portrayed a positive attitude towards practical work regardless of their teaching experience. Again, the positive correlation found in this study would have to be corroborated in larger studies before more definitive claims could be made.

4.5.4 Attitude reliability analysis test

Table 4.5-2 shows the correlation between the attitudes of the respondents and the questions answered. The lowest correlations were found between Questions 1-3 and attitudes. The highest correlation was identified between respondents and Question 4, with a correlation coefficient of 0.57. In contrast, Question 1-3 displayed the highest correlation coefficient after the standardised alpha was deleted. The correlations increased with the removal of the standardized alpha from the equations, for all attitudes- question relationships investigated.

The Cronbach's alpha is a measure of inter-correlation between the items. These correlations aided in explaining how the respondent's attitudes to the numerous questions were related. See Table 4.5-2 below for the Cronbach alpha coefficient for each item on the Likert scale.

Table 4.5-2 Attitude reliability analysis

Variables	Cronbach's alpha and 95% Cl: 0.71 (0.47, 0.82) Summary for scale: Mean=50.3556 Std. Dev. =3.60653 Valid-N:45 Standardized alpha: 0.74 Average inter-item corr.:0.21	
	Item- Total correl.	Alpha if deleted
Question 1	0.17	0.74
Question 2	0.36	0.69
Question 3	0.14	0.72
Question 4	0.57	0.65
Question 5	0.46	0.68
Question 6	0.52	0.67
Question 7	0.29	0.7
Question 8	0.36	0.69
Question 9	0.41	0.69
Question 10	0.41	0.69
Question 11	0.46	0.68

4.6 Biology teachers' views towards practical work

This sub-section discusses the general results obtained from respondents in ranking 10 practical aims as investigated using a rank-order scale. The histograms in this section show the participants' responses to 10 given practical aims that required the Biology teachers to arrange them in their order of importance. This analysis was used as a part-indicator of the

respondents' views as per gender and number of years' teaching in the testing of null hypotheses 3 and 4.

4.6.1 Mixed model ANOVA in R (IMER PACKAGE)

Figure 4.6.1 below shows respondents' general response on how they ranked the importance options individually as it appears in the rank-order histograms presented in Appendix F. The figure shows the importance options as ranked from the highest to the lowest. It was observed that the importance options were fairly ranked, with importance option 10 being ranked slightly higher and importance option 6 ranked lower. The graph shows a relatively small difference in the rankings of the importance options. Therefore, there is no significant difference between the rankings of the importance options (p= 0.23 > 0.05).

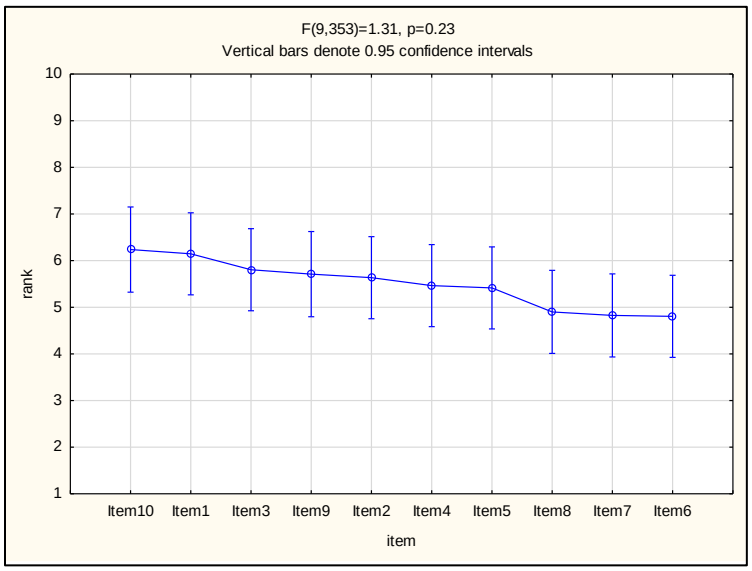


Figure 4.6.1 Ranking order for the 10 importance options

4.6.2 Null hypothesis 3 (There is no significant difference between male and female Biology teachers' attitudes towards practical work)

Hypothesis 3- There are no statistically significant differences between male and female respondents with respect to their mean ranking scores in importance options 1 (*To encourage accurate observing and careful recording*), importance option 2 (*To promote simple, common-sense, scientific methods*), importance option 4 (*To give training in problem-solving skills*),

importance option 5 (*To fit the requirement of practical examination*), importance option 6 (*To be an integral part of the process of finding facts by investigation*), importance option 7 (*To elucidate the theoretical work so as to aid comprehension*), importance option 8 (*To verify facts and principles already taught*), importance option 9 (*To arouse and maintain interest in the subject*); and importance option 10 (*To make physical phenomena more real through actual experience*) as narrated in the previous sub-section 4.6. There was a significant difference between male and female respondents with respect to importance option 3 *(To develop manipulative skills)* where ($p < 0.01$).

The following figures show how male and female respondents ranked each of the 10 practical aims:

4.6.2.1 Gender on importance option 1

Figure 4.6.2 shows that female teachers viewed importance option 1 as more important than male teachers did. It is, however, not statistically significant as the p= 0.24 lies above 0.05.

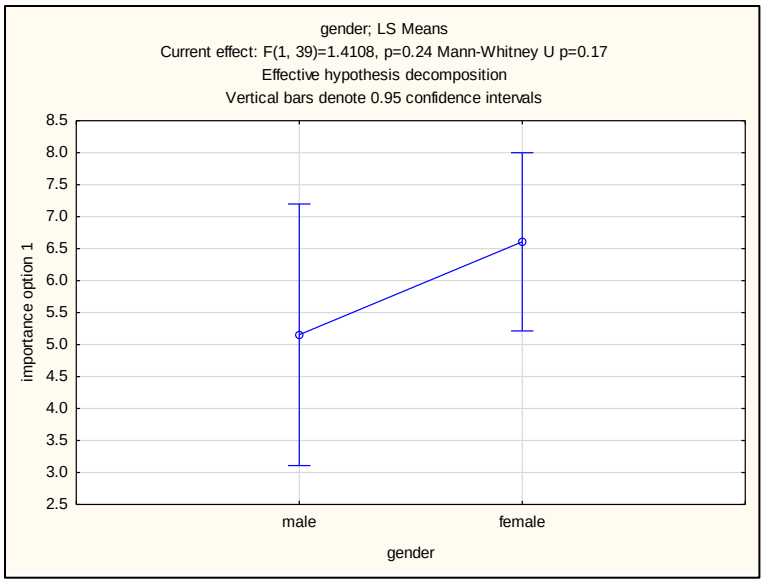


Figure 4.6.2 Gender difference on importance option 1

4.6.2.2 Gender differences on importance option 2

Figure 4.6.3 shows that more male teachers rated it more important than the female teachers did. This is, however, not statistically significant as the p=0.41 is greater than 0.05.

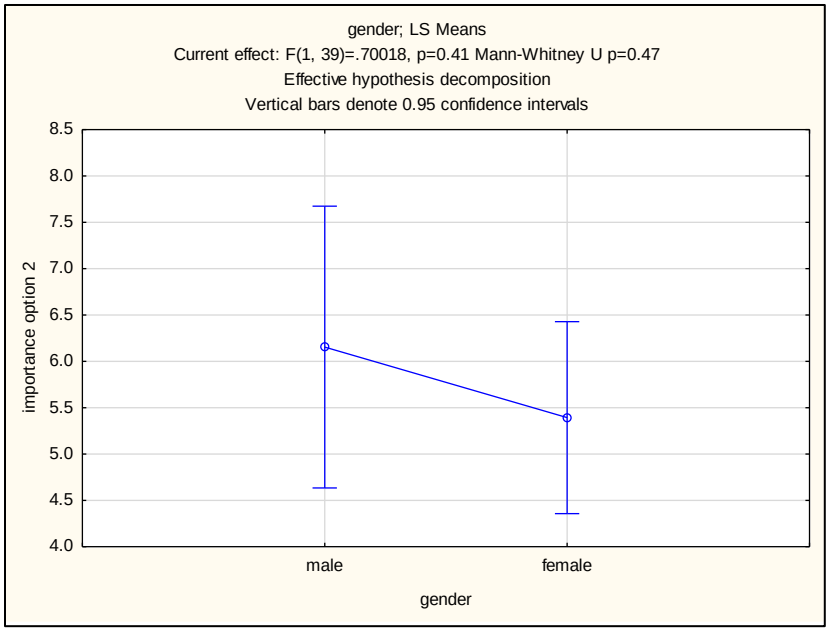


Figure 4.6.3 Gender difference on importance option 2

4.6.2.3 Gender differences on importance option 3

Figure 4.6.4 indicates that female teachers rated this option more important than male teachers did. There is a trend that more female teachers view this aim as more important. The graph shows that this finding is statically significant as p=0.01 is less than 0.05.

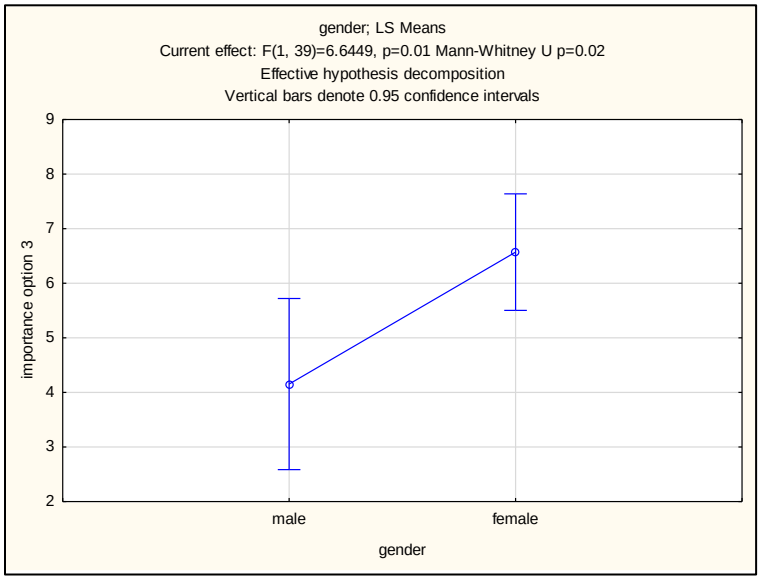


Figure 4.6.4 Gender difference on importance option 3

4.6.2.4 Gender differences on importance option 4

Figure 4.6.5 indicates a trend that female teachers viewed this option as more important than male teachers did, although it is not statistically significant for p=0.16 because it is greater than 0.05.

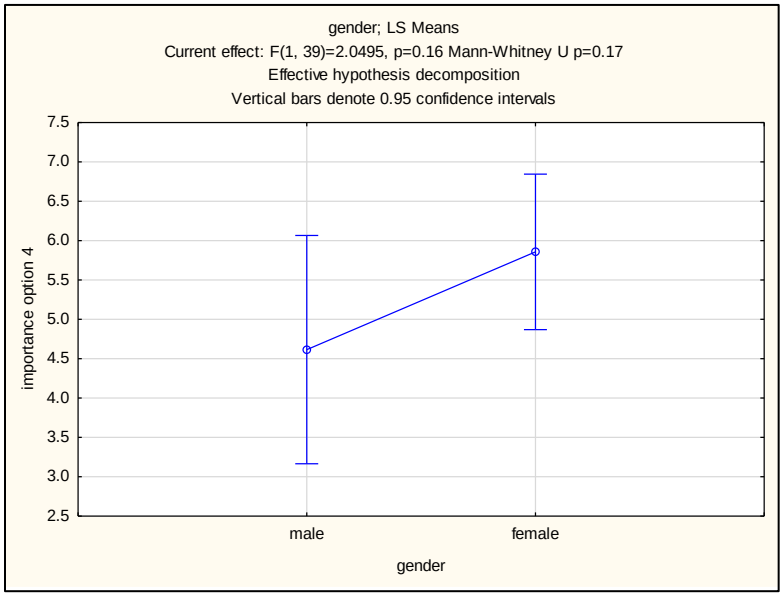


Figure 4.6.5 Gender difference on importance option 4

4.6.2.5 Gender differences on importance option 5

Figure 4.6.6 shows that female teachers viewed this aim as more important than male teachers did, but it is statistically not significant as p=0.14 is greater than 0.05

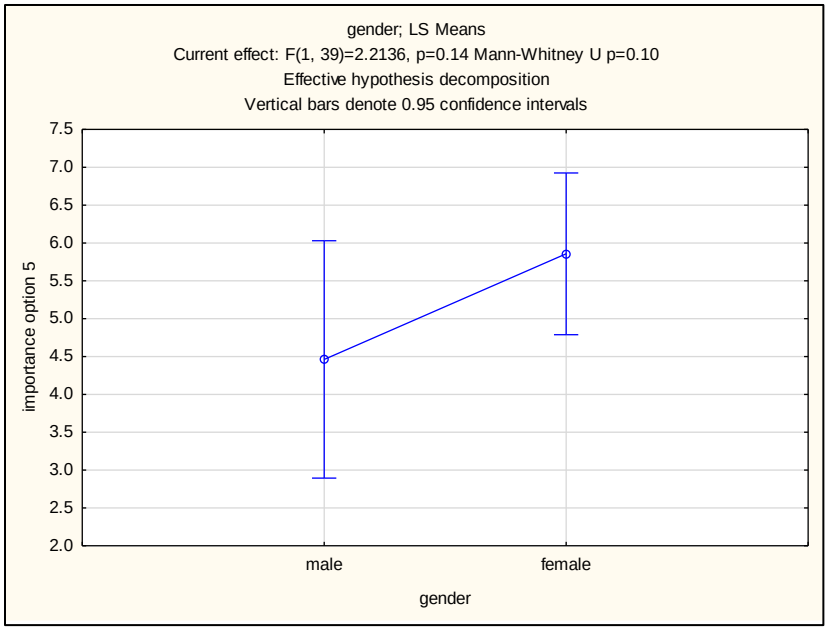


Figure 4.6.6 Gender difference on importance option 5

4.6.2.6 Gender differences on importance option 6

Figure 4.6.7 shows a trend that male teachers viewed this aim as more important than female teachers did but it is statistically not significant as p=0.12 is greater than 0.05

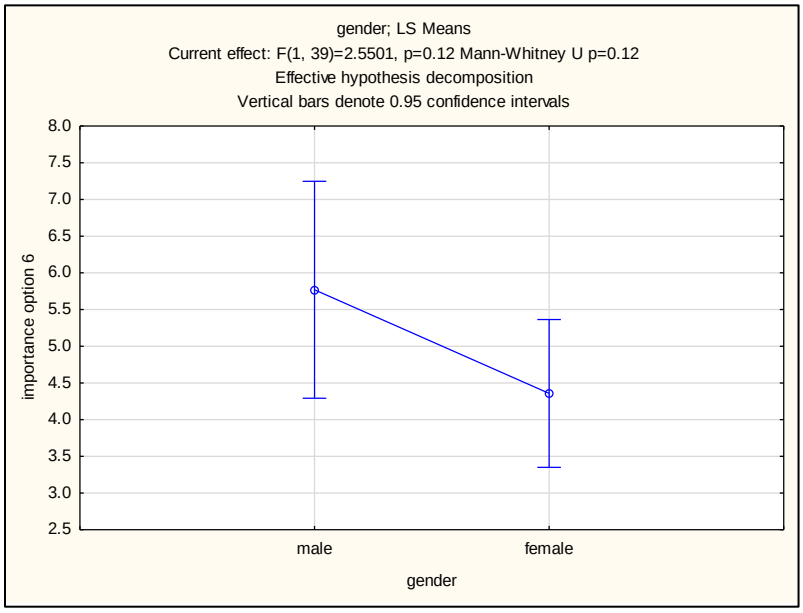


Figure 4.6.7 Gender difference on importance option 6

4.6.2.7 Gender differences on importance option 7

Figure 4.6.8 indicated that male teachers viewed this practical aim as more important than female teachers did but it is not statistically significant as the p=0.24 is greater 0.05

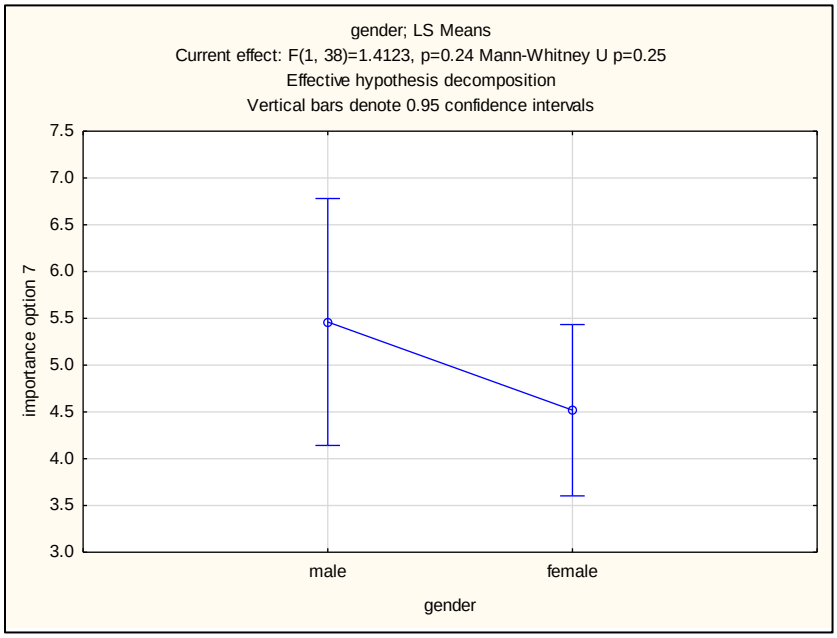


Figure 4.6.8 Gender difference on importance option 7

4.6.2.8 Gender differences on importance option 8

Figure 4.6.9 shows that the majority of the male teachers viewed this practical aim as slightly more important than female teachers did, but this practical aim is statistically not significant as p=0.36.

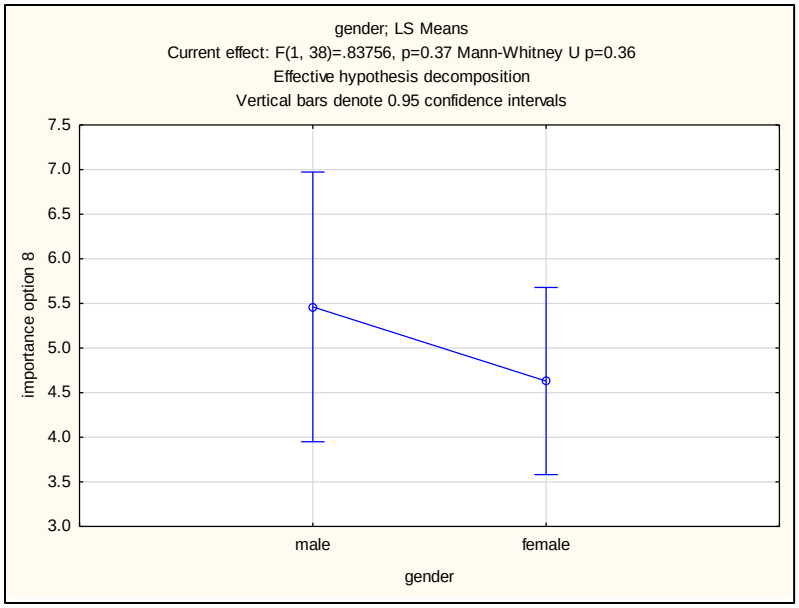


Figure 4.6.9 Gender difference on importance option 8

4.6.2.9 Gender differences on importance option 9

Figure 4.6.10 shows that male teachers rated this practical aim as more important than female teachers did, but this practical aim is statistically not significant as p=0.09.

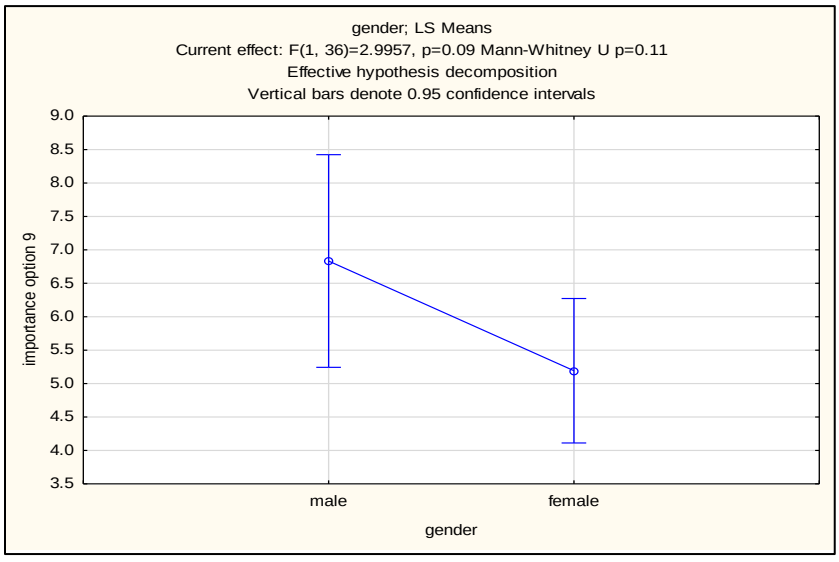


Figure 4.6.10 Gender difference on importance option 9

4.6.2.10 Gender differences on importance option 10

Figure 4.6.11 below shows that a trend was observed that the male teachers ranked this practical aim as slightly more important than the female teachers did but it is statistically not significant as p= 0.43 is greater than 0.05.

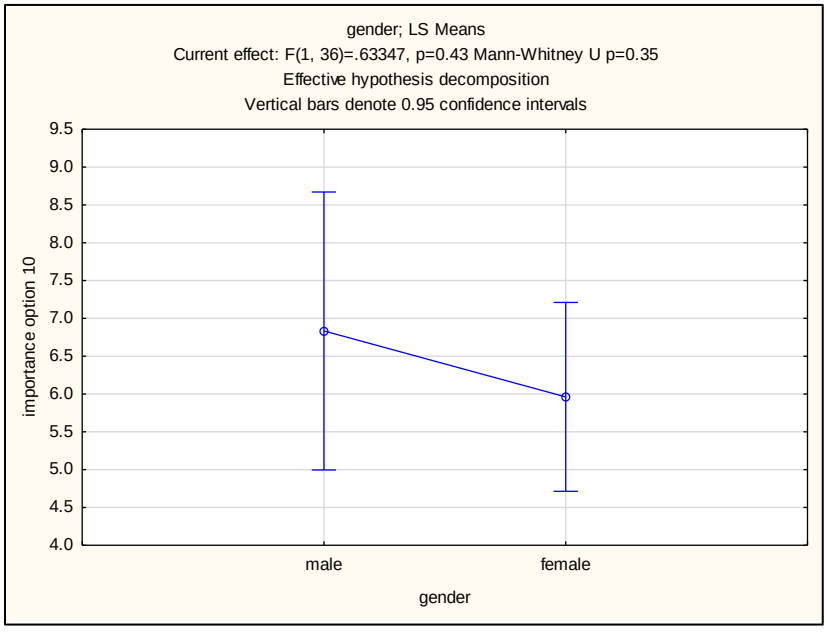


Figure 4.6.11 Gender difference on importance option 10

4.6.3 Null hypothesis 4 (There is a significant relationship between the number of years' teaching and views on practical work)

There are no statistically significant differences between the mean ranking scores of importance options (individual items) and the years of teaching. None of the 10 importance options which were tested were statistically significant. Differences in rankings are statistically significant when the p-value is equal to or smaller than 0.05 ($p < 0.05$) whereas the correlation coefficients lie between -1 and 1. The closer the correlation is to 1, the stronger the positive correlation is.

Table 4.6-1 shows the relationships between respondents' number of years teaching and the rankings of the importance options.

Table 4.6-1 Relationship between number of years teaching and importance options

Variable 1 (years teaching)	Variable 2	Pearson	Pearson p-val	Spearman	Spearman p-val	#cases
1	Importance option 1	-0.28	0.08	-0.24	0.14	40
2	Importance option 2	-0.08	0.61	-0.12	0.46	40
3	Importance option 3	-0.12	0.46	-0.14	0.38	40
4	Importance option 4	-0.22	0.17	-0.15	0.36	40
5	Importance option 5	0.07	0.65	0.07	0.65	40
6	Importance option 6	0.06	0.72	0.1	0.54	40
7	Importance option 7	0.12	0.45	0.15	0.36	39
8	Importance option 8	0.11	0.49	0.15	0.36	39
9	Importance option 9	0.12	0.49	0.1	0.56	37
10	Importance option 10	0.2	0.25	0.24	0.15	37
11	Attitude	0.15	0.34	0.12	0.45	44

The correlations between the importance options' significance in relation to number of years' teaching are analysed individually below:

1. **Importance option 1:** There is no statistically significant relationship (p= 0.08 > 0.05) between 1 year of teaching and importance option 1. However, a negative correlation (-0.28) was observed between the years of teaching and importance option 1. This means

that for every one unit increase in the number of teaching years, the likelihood of a participant choosing importance option 1 decreases by -0.28. This negative correlation is a trend because the p=0.08 is close to the 0.05 level. This might show as statistically significant in larger samples.

2. **Importance option 2:** There is no statistically significant relationship (p= 0. 61 >0.05) between years of teaching and importance option 2. However, a negative correlation of (-0.08) was observed between the years of teaching and importance option 2. This means that for every one unit increase in the number of years' teaching, the likelihood of a respondent choosing importance option 2 is decreased by -0.08.
3. **Importance option 3:** There is no statistically significant relationship (p= 0.46 > 0.05) between years of teaching and importance option 3. However, a negative correlation of (-0.12) was observed between the years of teaching and importance option 3. This means that for every one unit increase in the number of teaching, the chances of the respondents choosing importance option 3 is reduced by -0.12.
4. **Importance option 4:** There is no statistically significant relationship (p= 0.17 > 0.05) between years of teaching and importance option 4. However, a negative correlation of (-0.22) was observed between the years of teaching and importance option 4. This shows that with every unit increase in the number of years' teaching, the likelihood of the respondents choosing importance option 4 is reduced by -0.22.
5. **Importance option 5:** There is no statistically significant relationship (p= 0.65 > 0.05) between the years of teaching and importance option 4. However, a positive correlation of (0.07) was observed between the years of teaching and importance option 5. This shows that with every unit increase in years of teaching, the likelihood for the respondents choosing importance option 5 is increased by 0.07.
6. **Importance option 6:** There is no statistically significant relationship (p= 0.72 > 0.05) between the years of teaching and importance option 6. However, a positive correlation of (0.06) was observed between the years of teaching and importance option 6. This means that with every unit increase in years of teaching, the likelihood of the respondents choosing importance option 6 is increased by 0.06.

7. **Importance option 7:** There is no statistically significant relationship (p= 0.45 > 0.05) between the years of teaching and importance option 7. However, a positive correlation of (0.12) was observed between years of teaching and importance option 7. This means that with every unit increase in years of teaching, the likelihood of respondents choosing importance option is increased by 0.12.
8. **Importance option 8:** There is no statistically significant relationship (p= 0.49 > 0.05) between the years of teaching and importance option 8. However, a positive correlation of (0.11) was observed between years of teaching and importance option 8. This means that with every unit increase in the years of teaching, the chances of the respondents choosing importance option 8 is increased by 0.11.
9. **Importance option 9:** There is no statistically significant relationship (p= 0.49 > 0.05) between the years of teaching and importance option 9. There is, however, a positive correlation of (0.12) which was observed between years of teaching and importance option 9. This means that with every unit increase in the years of teaching, the likelihood of respondents choosing importance option 9 increased by 0.12.
10. **Importance option 10**: There is no statistically significant relationship (p= 0.25 > 0.05) between the years of teaching and importance option 10. However, a positive correlation of (0.2) was observed between the years of teaching and the importance option 10. This means that there is an increase of 0.2 in the likelihood of respondents choosing importance option 10 with every unit increase.

4.7 Qualitative interpretation of results

4.7.1 Analysis of Qualitative questions

The quantitative component of the questionnaire was supplemented by three questions that focused on the reasons why respondents had ranked the importance options in the way they did. Answers to the qualitative questions were subjected to a substance analysis pointed at distinguishing the patterns that developed. The findings of this analysis are presented in Tables 4.7-1, 4.7-2 and 4.7-3 below.

4.7.1.1 Why did you rank the first three items as the most important?

The table below shows respondents' reasons for ranking the first three importance options as most important.

Table 4.7-1 Responses to the first question

Biology teachers' responses
Reason 1: Concerns about developing critical thinking skills, problem solving skills and manipulative skills
It is geared towards assisting learners to develop scientific thinking, manipulative skills, problem-solving skills as well as critical thinking skills.
Reason 2: Concerns of learners relating to subject matter
It helps learners gain sensory experience as well as to develop a scientific attitude rather than just concentrating on subject theory. Practical work is done to prove a hypothesis through experiments.
Reason 3: Importance of having science background
It is important to have a clear background of science, especially related to the practical work in order to help them score good marks in practical examination as well as in helping them gain the ability to solve science related problems.
Reason 4: Interest of learners in Biology

It is important for leaners to have interest in a subject such as Biology. Therefore, before considering other practical aims, one has to stimulate the interest of learners towards the subject.

4.7.1.2 Why did you rank the last three items as the least important?

The table below shows respondents' reasons for ranking the first three importance options least important.

Table 4.7-2 Responses to the second question

Reason: Prioritizing of practical aims
It is more important to consider practical principles for immediate benefit of learners gained from practical activity processes. Before learners sit for practical examinations, they need to have enhanced all of the other practical aims. Learners score a good mark after acquiring all necessary scientific skills. Some practical aims are easy to accomplish as compared to those highly ranked.

4.7.1.3 What are your concerns about practical work?

The table below shows the concerns about practical work as raised by respondents.

Table 4.7-3 Responses to the third question

Inadequate practical equipment
Schools do not have enough resources to conduct practical work. This is a limiting factor in carrying out practical work. It becomes hard to implement practical activities as required by the Biology syllabus because of the scarcity of resources. Learners tend to lose interest in practical activities which affects their practical

examination performance because they struggle to relate to questions asked due to lack of practice.
Time allocation
Time allocated to a period is not enough to complete a practical activity, considering that some practical activities require more than the 40 minutes allocated to it as well as the number of learners in a class.
Overcrowded classrooms
A lot of learners are allocated to a classroom therefore, causing havoc in class and then gives a teacher a hard time teaching because they spend most of the time on disciplining learners in class. It is also therefore very hard to control a big group of learners in a laboratory. In addition to this, the laboratories are small and cannot accommodate all learners in a class at a time.
Difficulties in explaining results
It becomes a challenge to explain to learners a practical activity with contradicting results to the theoretical knowledge acquired before the experiment was done.

4.8 Summary

This chapter presented, analysed, interpreted and discussed the data on the views and attitudes of Biology teachers towards Biology practical work in the Khomas region, Namibia. The data were collected using a questionnaire and answers were analysed. Overall, the teachers seemed to have diverse views on the importance of practical aims. The researcher conducted statistical analyses that show differences in the way the respondent views the importance of practical aims based on varying numbers of years of teaching experience.

Although there was no statistical significance, a trend was ascertained. It emerged that Biology teachers with more years teaching experience ranked the practical aims that have to do with scientific skills more important than did Biology teachers with fewer years' teaching experience. Another finding was that in most *importance options*, more male teachers ranked the importance options higher than the female teachers did. However, it emerged that both male and female respondents with varying years' teaching experience had a positive attitude towards practical work.

Teachers pointed out some practical work issues that they experience when doing practical work: (i) the school context i.e. little time allocation to practical sessions, too many learners in a classroom and learners are not interested in activities due to limited resources; (ii) financial constraints i.e. limited available resources to run practical activities; (iii) little support from subject advisors. The findings show that there is a disjuncture between teachers' attitudes towards practical work and the challenges that they encounter in implementing practical work. It emerged that Biology teachers had a positive attitude towards practical work in spite of the fact that they had challenges in implementing the work. However, the researcher has made suggestions that could help improve the challenges faced by teachers. These will be discussed in the next chapter as well as in the *Summary, Recommendations* and C*onclusion.*

5 Summary, recommendations and conclusion

5.1 Introduction

The study assessed the views and attitudes of Biology teachers towards practical work in the secondary schools of the Khomas region in Namibia. In particular, it sought to find out the reason behind learners' low performances in the Biology practical examinations in the final examinations. Therefore, assessing Biology teachers' views and attitudes was seen as a way to find a solution to the problem.

A quantitative research method was used to gather and analyse data. This involved the use of a questionnaire that was handed out to Biology teachers from secondary schools within the Khomas region, Namibia. In this chapter, the researcher will provide a *summary*, *conclusion*, *suggestions* and *recommendations* based on the study.

5.1.1 Main findings

5.1.1.1 Teachers' views and attitudes towards practical work

These findings are drawn from the questionnaires that were completed by Grades 9 and 11 Biology teachers. The main argument for undertaking this study, raised in Chapter 1 is that learners perform poorly in their practical examination: Paper 3. Ministry of Education, Examiner's report (2016;2017) showed that practical examinations remained the biggest challenge within the Namibian education system. Learners continue to have problems in performing successfully in practical examinations due to a lack of high-level procedural and conceptual skills. Teachers' attitude and views towards practical work is important to carrying our practical activities in science and how learners perform in practical work is partly depended on teachers' attitudes and views of practical work, therefore this was the focus of this study.

The findings of the study show that teachers show a positive attitude towards practical work although they face many challenges in administering the practical activities which are required of them. Kerr (1964) carried out a survey on the attitude of Science teachers towards practical work which was compared to a study by Beatty and Woolnough (1982) who had surveyed

Science teachers' attitudes towards practical work, following Circular 10/15 which was in use at the time. They indicated that teachers' responses to ranking practical aims were constant, but raised questions about people's expressed sentiments and their actions. It was of concern for these writers whether teachers could make the shift from the use of standard practical activities to discoveries. The findings of this study also reveal that teachers considered the given practical aims as equally important to practical work. However, the following three aims were ranked as the least important by most of the respondents:

(i) *To verify facts and principles already taught;*

(ii) *To be an integral part of the process of finding facts by investigation;* and

(ii) *To elucidate the theoretical work so as to aid comprehension.* These were ranked slightly less important. Teacher responses indicated how important they considered the aims of practical work. Their rankings show a positive view and attitude towards practical work, this is revealed from the consistency in ranking of the importance options that were given in the questionnaire.

Yildiz, Akpinar, Aydogdu and Ergin (2006), on the other hand, indicate that the following were ranked as most important; (i) *to help develop students' observational skills and* (ii) *to ease learning, since doing experiments involves using all the students' senses.* Yildiz *et al.* (2006), further state that theirs study findings reveal that teachers consider that experiments improve students' manipulative and cognitive skills and develop a sense of cooperative skills among students which are also seen as the other important aims. The items related to *building up scientific curiosity* and *helping them gain a sense of possession of laboratories* were considered by teachers to be the least important items when compared with other items on the scale. Kerr (1964), however, argues that there still remains some doubt about whether teachers really understand and interpret the practical aims when taking part in surveys such as this.

According to Ualesi and Ward (2018), the concerns have been raised globally that the lack of interest by teachers towards teaching Science is seen to impact negatively on learners; therefore they researched the attitudes of Science teachers towards the subject in New Zealand. Van Aalderen-Smeets, Walma and Asma (2012) used a framework which covered a

multi-dimensional view of attitudes to measure the attitudes of teachers towards Science. This framework included affective dimensions which involve feelings related to teaching Science, which can be positive and negative. Findings of this study show that teachers are enthusiastic when it comes to carrying out practical work with learners. Kerr (1964) described how positive feelings would be associated with the enjoyment of Science teaching and negative feelings would be associated with fear and anxiousness about teaching Science. Kerr (1964) further indicated that such emotions can occur simultaneously, that is, a teacher can enjoy teaching Science yet at the same time experience anxiety about teaching Science. Teachers' attitudes towards teaching Science are important as these attitudes influence their interest in teaching and carrying out subject objectives (Kerr, 1964).

From Kerr's findings, the gender perspective on the practical aims showed a higher means of male teachers as compared to that of the female teachers. However, Yildiz *et al.* (2006), state in the findings of their study that in terms of gender, the attitudes towards practical aims was not found significant although the female participants had shown a higher means of ranking the practical aims as compared to the male participants. Zaidi (2010) carried out research on how the human brain works and gave an explanation as to why there is a difference between female and male brain functions and structure. According to Zaidi (2010), the left side (used for logical thinking) of the male brain is bigger than that of the right brain. Females use the whole brain during decision- making, unlike males who only use the left side of the brain. Females tend to think more observantly, whilst males think logically. This then concludes why male teachers have indicated most practical aims as more important than the female teachers did.

The discussion above offers tentative observations and interpretations, and further studies are necessary to provide corroborative evidence.

5.2 Summary

This study sought to assess Biology teachers' views and attitudes towards practical work in the Khomas region of Namibia. For ease of reference, the findings from teachers' responses from the questionnaire are summarized.

Chapter 4 indicated the analysis of the data attained from teachers with regard to their attitude towards practical work. It shows that teachers revealed a positive attitude towards practical work as a component of the Biology syllabus. The findings indicate that teachers generally have positive attitudes towards practical work as evidenced by their agreeing with most questions posed. They indicated their dedication to working extra hours to conduct practical work due to little time allocated to this activity in school timetables. They expressed that great support is required by learners during practical activities and they do what they are able to, in order to fulfil the requirement that learners practice practical work. Teachers also pointed out how important it is to them to work together with teachers from other schools in preparation of most Biology practical activities.

The study employed closed-ended questions (Likert scale), rank-order scale and open-ended questions to follow up on the rank-order scale in the questionnaire. The population of the study comprised 46 Grade 9 and 11 Biology teachers in the Khomas region, Namibia. Grade 9 and 11 Biology teachers were chosen for the study because they are responsible for teaching Biology at secondary school level; and considering the fact that these two grades are two of the grades in which learners write external examinations, they were found to be the appropriate target group to provide rich information in this regard. All secondary schools offering Biology were selected for the defined population for this study and a total of 46 Biology teachers for Grades 9 and 11 from the fifteen schools agreed to participate in the study.

Thus, a total of forty-six (46) Biology teachers participated in the study, and all the respondents were required to complete the questionnaire after having signed the letter of consent. They were, however, given the right to withdraw from participating at any point. The data were then analysed from the questionnaires using graphs and tables.

To maintain ethical standards, the respondents were provided with all the details of the study so that they could understand what the research was all about. The purpose and objectives were clearly explained to respondents. Respondents' information was kept confidential as promised.

Findings of the study indicated that Biology teachers at secondary school level felt that practical work is indeed a crucial component of Biology. It helps learners develop multiple scientific skills, as well as helping them to understand the theoretical work better. It emerged that most schools were not well-equipped with practical resources and this fact negatively affected the implementation of the Biology Practical objectives. Respondents indicated that they receive materials once in a while and these materials barely cater for all the learners. This also demoralizes the learners because they do not all get an opportunity to either manipulate objects or to see specimens. Teachers expressed their concern about over-crowded classes, which they said makes it difficult to control the learners in a practical class setting, and reduces the amount of individual teacher attention that learners deserved. Teachers stated that these are on-going issues which seem to get no attention.

Challenges encountered throughout the study period were as follows:

i. Collecting data for this study was somewhat difficult due to teachers' busy schedules at the time of data collection which comprised setting examinations, marking, and other duties assigned to them.
ii. Biology teachers felt as if so much of their time was being wasted as they had to be schooled on the study. Most teachers approached refused to take part in the study due to their heavy teaching duties.
iii. The researcher could not reach all the schools that she had planned to include, due to permission being denied by school principals. Therefore, the study data is limited to only 46 respondents.
iv. Some school principals refused to allow the researcher to carry out the study at their schools; some reasoned that the teachers were not available whilst others said their schools are always involved in students' research and they would no

longer allow it. At the end, some of the school principals gave the necessary permission but their teachers could not/did not return completed questionnaires; therefore there was a decline in the number of participating teachers.

v. Due to the population of the study being so widespread in the region, the researcher faced financial challenges because she had to drive back and forth to the schools when dropping off and picking up the questionnaires; especially because not all schools had teachers who had completed the questionnaires on t

Practical work as a part of Science is not easy as it is demanding if one were to accomplish its goals fully. Teachers and learners are faced with numerous challenges in the preparation of practical work which must be considered when they organise the activities. Schools have different settings and conditions, therefore they face different challenges.

Constraints have been identified in the *results* section of this study as: inadequate laboratory space, unavailability of resources, overcrowded classrooms, few teachers allocated to teaching Biology, inadequate support from authorities. If these constraints can be improved, then there is hope for delivering quality education to each Namibian child. But despite the challenges disclosed during this study, it is the researcher's hope that the findings will be useful for further studies in this area. Undertaking this study has opened her eyes to seeing what it is like out there and for that reason she is aware of the intensity and commitment required to carry out a study of this kind.

5.3 Recommendations for stakeholders

This study aimed to assess the views and attitudes of Biology teachers towards practical work in the Khomas region, Namibia. Based on the data interpreted from the findings collected during the study, the researcher finds the need to make a few recommendations to stakeholders which emerge from the findings of the study.

These recommendations are based on the understanding that teachers generally have positive attitudes towards practical work, which provides a solid foundation for improving practical work in schools.

i. Firstly, the results showed that most Biology teachers are challenged by a lack of practical equipment and struggle to improvise when they run out of available material. For this, the researcher recommends that the appropriate department in the Education Ministry ensure availability of practical resources at the schools in the region, in order to complete learning and teaching.

ii. Funds should be made available from the Ministry, to assist in supplying equipment to schools.

iii. Looking at the aspect of teachers struggling with overcrowded classes, the researcher recommends that the Ministry of Education Arts and Culture employ more Biology teachers to cater for effective learning and to practise the 1:35 teacher learner ratio recommended by the Ministry.

iv. It has become evident that some schools do not have laboratories where teachers can conduct practical lessons. Therefore, the researcher recommends that all schools be equally equipped with a laboratory setting and this should be seen and tackled by the necessary department in the Ministry.

v. Seeing that teachers expressed the sentiment that they have little support from their subject advisors, the researcher recommends that Biology subject advisors make themselves available to visit schools more often in order to track the Biology teachers and to provide them with the necessary support in delivering adequate content to the learners.

5.4 Recommendations for future studies

Based on the findings of this study, issues that might interest future students in this area have arisen. This may be beneficial especially because the Biology teachers who took part in this study represented only a small number of Biology teachers in the Khomas region of Namibia.

This was due to a negative response from either Biology teachers themselves or school principals of some of the Khomas region secondary schools. In this manner, the discoveries of this study cannot be seen to represent the Biology teachers within the region, and cannot be summed up for generalising purposes due to its phenomenological limitations. The researcher in this way suggests that future studies consider a greater sample of the Biology teachers within the Khomas region to corroborate the findings of this study. Given the findings of this study, the researcher encourages researchers embarking on future studies to investigate the attitudes and views of learners towards practical work as well as doing an observation during their study, as this might give greater insight into how practical work is enacted in classrooms in schools located in different contexts. Furthermore, it is recommended that larger studies are conducted that include observations of practical work done in schools because one limitation of this study is that it is based on self-report data. What teachers say they do, are not necessarily what they do. It is also recommended that future instruments that measure teachers' attitudes towards practical work include both positive and negative statements so that acquiescence bias may be reduced. Acquiescence bias relates to the tendency of respondents to reply more positively to statements that are positively worded.

5.5 Conclusion

The study outcomes elucidate that Biology teachers have positive attitudes towards practical work. The results of the research question and study hypotheses show positive attitudes and views of the Biology teachers towards practical work. Although teachers have positive attitudes towards practical it does not mean that this leads to actions. Therefore, further studies are required such as for classroom observations to see what teachers actually do during practical work lessons. It was concluded that despite the positive response from the teachers, the teaching and learning process may be hindered by challenges that arise during the process. If teachers are not equipped with adequate materials for the lessons, it impacts negatively on achieving the syllabus objectives. This makes it difficult to teach effectively, therefore, it is recommended that teachers have access to all the necessary study material, in order to accomplish the teaching objectives. Teachers should, however, raise this concern with the

Ministry of Education Arts and Culture to make sure that the necessary adjustments and improvements are considered. Furthermore, teachers are advised to suggest alternatives to substitute materials when possible or to use other teaching means.

References

Abrahams, I. and Reiss, M. J. (2012). Practical work: Its effectiveness in primary and secondary schools in England. *Journal of Research in Science Teaching*, 49(8), 1035–1055. doi: 10.1002/tea.21036.

Abudu, K. A. and Gbadamosi, M. R. (2014). Relationship between teacher's attitude and student's academic achievemnt in senior secondary school chemistry. A case study of Ijebu-Ode and Odogbolu Local Government Area of Ogun state. *Wudpecker Journal of Educational Research*, 3(3), 35–45. doi: 10.13140/RG.2.1.1892.3680.

Aikenhead, G. and Ryan, A. (1992). The Development of a New Instrument : " Views on Science-Technology-Society " (VOSTS), 76(5), 477–491.

Ajunwa, C.A. (2000). *Acquisition of Physics Process Skills by Secondary School Students*. Published doctoral dissertation. University of Nigeria.

Aloovi, O.A. (2016). *Biology teachers' lived experiences of the Namibian senior secondary certificate (NSSC) curriculum*. Published Master thesis. University of Stellenbosch.

Amukugo, E.M. (1993). *Education and politics in Namibia: Past trends and future prospects*. Windhoek: Gamsberg Macmillan Publishers (Pty) Ltd.

Angula, N. (1993). *Towards education for all: a development brief for education, culture, and training.* Ministry of Education and Culture Namibia. Windhoek: Gamsberg Macmillan Publishers (PTY) Ltd.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Beatty, J.W. and Woolnough, B.E. (1982). Practical Work in Science 11-13 Sciences: the context, types and aims of current practice. *British Educational Research Journal*, 8(1), 3-108.

Bell, S. (1996). *Learning with information systems: Learning cycles in information systems development*. New York: Routledge.

Bennett, J. and Kennedy, D. (2001). Practical work at the upper high school level: The evaluation of a new model of assessment. *International Journal of Science Education*, 23(1), 97–110. doi: 10.1080/09500690119244.

Bless, C. and Higson-Smith, C. (2000). *Fundamentals of social research methods. An African perspective.* 3rd edition. Cape Town: Juta.

Brown, C. R. (1995). *The effective teacher series: the effective teaching of biology*. London: Longman

Bybee, R.W. (2000). *Teaching science as inquiry. In J. Minstrell & E. H. van Zee Inquiry into learning and teaching in science*. New York: American Association for the Advancement of Science.

Capel, S., Leask, M. and Turner,T. (2009). *Learning To Teach In The Secondary School*: *A companion to school experience*. 5th edition. London: Routledge

Chawla, C., Jain, V. and Mahajan, T. (2013). A Study on Students ' Attitude Towards Accountancy subjects at senior secondary school level. *International Journal of Management*, 4(3), 177–184.

Childs, P., Flaherty, A. and Limerick, I. (2016). Symposium on Chemistry and Science Education. *Science Education Research and Practical Work*. TU Dortmund University of Technology, 26-28 May

Christian, C.G. (2000). *Ethics and politics in qualitative research*, 133–155.

Cohen, L., Lawrence, M. and Keith, M. (2006). *Research methods in education*, *Professional Development in Education*. 5th edition: Routledge. doi: 10.1080/19415257.2011.643130.

Cook, D. A. and Anthony, A. (2016). The cross-cutting edge Motivation to learn : an overview of contemporary theories.*Medical education*, 50(10), 997–1014. doi: 10.1111/medu.13074.

Creswell, J. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage.

Creswell, J. (2012). *Educational research planning, conducting and evaluating quantitative and qualitative research*. 4th edition. Boston: Pearson.

Creswell, J.W. and Clark, P. V. (2007). *Designing and Conducting Mixed Methods Research.* Thousand Oaks: Sage.

DaCosta, J.W. (2007). Research methods in educational leadership and management in *Reviewing educational literature in Briggs*, pp. 63–67.

Dahlstrom, L. (1995). Teacher education for independent Namibia: from the liberation struggle to a national agenda. *Journal for Education for Teaching*, 21(3), 275-288.

De Vos, A. S., Fouche, C. & Strydom, H. (2005). *Study at grassroots: For the social sciences and human service professions.* 3rd edition. Pretoria: Van Schaik.

Dillon, J. (2003). A Review of the research on practical work in school science. Unpublished master's thesis. King's College London.

Doran, R., Lawrenz, F. and Helgeson, S. (1994). *Research on assessment in science. In D. Gabel (Ed.), Handbook of research on science teaching and learning.* New York: Macmillan.

Glasow, P. A. (2005). *Fundamentals of Survey Research Methodology.* Mclean Virginia: Washington DC.

Goodson, I. (1983). *School Subjects and Curriculum Change: Case Studies in Curriculum History.* London: Croom Helm.

Gudula, Z. (2017). *The influence of language on the teaching and learning of Natural Sciences in Grade 7.* Published master's thesis. University of Western cape.

Hailombe, O. (2011). Education equity and quality in Namibia: A case study of mobile schools in the Kunene region. Unpublished doctoral dissertation. University of Pretoria.

Hattingh, A., Aldous, C. and Rogan, J. (2007). Some factors influencing the quality of practical work in science classrooms. *African Journal of Research in SMT in Education*, 11(1), 75–90.

Hinneh, J. T. (2017). Attitude towards practical work and students' achievement in biology: A case of a private senior secondary school in Gaborone, Botswana. *IOSR Journal of Mathematics*, 13(4), 6–11.

Hodson, D. (1992). Assessment of practical work. *Science and education*, 1(2), 144–155.

Hodson, D. (1996). Practical work in school science: exploring some directions for change. *International Journal of Science Education*, 18(7), 755–760.

Hodson, D. and Hodson, J. (1998). From constructivism to social constructivism: a Vygotskian perspective on teaching and learning science. *School Science Review*, 79(289), 33-41.

Hornstra, L., Mansfield, C. and Veen, I. (2015). Motivational teacher strategies: the role of beliefs and contextual factors. *Learning Environments Research*. Springer Netherlands, 18(3), 363-392. doi: 10.1007/s10984-015-9189-y.

Issac, S. and Michael, W.B. (1997). *Handbook in research and evaluation: A collection of principles, methods, and strategies useful in the planning, design and evaluation of studies in education and behavioural sciences.* 3rd edition. San Diego, Educational and industrial testing services.

Jiao, X. (2005). Factors influencing students' approaches to learning: A case study of postgraduate students at the New Zealand University. Published master's thesis. Auckland University of Technology.

Johansson, M., Heldt, T. and Per, J. (2006). The effects of attitudes and personality traits on mode choic. *Transportation Research Part A: Policy and Practice*, 40(6), 507–525. doi: 10.1016/j.tra.2005.09.001.

Jones, A., Reed, R. and Weyers, J. (2016). *Practical skills in biology*. 4th edition. Harlow, England: Pearson.

Kandjeo-Marenga, H. U. (2008). *A case study of the nature of biology practical work in two secondary schools in Namibia*.Published doctoral dissertation. University of Western cape.

Kaptan, K. and Timurlenk, O. (2012). Challenges for Science Education. *Procedia - Social and Behavioral Sciences*. Elsevier B.V., 51, 763–771. doi: 10.1016/j.sbspro.2012.08.237.

Kapting'ei, P. and Rutto, D. K. (2014). Challenges facing laboratory practical approach in physics instruction in Kenyan district secondary schools. *International Journal of Advancement in Resarch & Technology*, 3(8), 13–17.

Katjavivi, P. Speech delivered by speaker of the National Assembly of the Republic of Namibia and Founding Vice Chancellor of the University of Namibia, Dr Peter Katjavivi, at the Commonwealth Parliamentary Association in London, 28 May 2016.

Kasiyo, C., Denuga, D. and Mukwambo, M. (2017). An Investigation and Intervention on Challenges Faced by Natural Science Teachers When Conducting Practical Work in Three Selected School of Zambezi Region in. *American scientific research journal of engineering , technology and science*, 34(1), 23–33.

Kerr, J.F. (1964). *Practical Work in School Science*. Leicester: Leicester University Press.

Keys, C.W. and Kennedy, V. (1999). Understanding inquiry science teaching in context: A case study of an elementary teacher. *Journal of Science Teacher Education*, 10(4), 101–106.

Kurtz, J. (1967). Biology in Science: A process approach. *The American Biology Teacher*, 29(3), 192-196.

Le Grange, L. (2008). The history of Biology as a school subject and developments in the subject in contemporary South Africa. *Southern African Review of Education*, 14(3) 89-105.

Lee, O. and Brophy, J. (1996). Motivational patterns observed in sixth-grade science classrooms. *Journal of Research in Science Teaching*, 33(3), 585–610.

Lee, M. C. and Sulaiman, F. (2018). The Effectiveness of Practical Work on Students' Interest towards Learning Physics. *International Journal of Humanities and Social Science Inventions*, 7(8), 35–41. doi: 10.15242/dirpub.hdir1217224.

Leen, C. C. (1989) *Understanding "Knowledge" the essential approach to teaching and learning.* Singapore: World Scientific Publishing.

Levy, P.S. and Lemeshow,S. (1999). *Sampling of populations: Methods and applications.*3rd edition. New York: John Wiley and Sons.

Lijnse, P.L. (1995). "Developmental research" As a way to an empirically based "Didactical Structure" of science. *Science Education*, 79(2), 189–199.

Likert, R. (1967). *Readings in attitude theory and measurement*. New York: Wiley and sons.

Madukwe, E. P., Onwuka, U. and Nyejirime, W.Y. (2019). Teachers ' Attitude as a Correlate of Students' Academic Performance. *International Journal of Research and Innovation in Social Science*, 3(1), 205–209.

Malathi, S. and Rohini, R. (2018). Problems faced by the Physical Science teachers in doing practical work in higher secondary schools at Aranthangi educational district. *International Journal of Science and Research*, 6(1), 133-135.

Marques, L., Praja, J. and Thompson, D. (2010). Practical Work in Earth Sciences Education : An experience with students in the context of a National Science Programme in Portugal Practical Work in Earth Sciences Education. *Research in Science & Technological Education*, 20(2), 143-164.

McIntyre, L.J. (1999). *The practical sceptic: Core concepts in sociology*. Mountain View, CA: Mayfield Publishing.

Mert and Ekici, G. (2015). Factors affecting biology lesseon motivation of high school students.*Procedia Social and Behavioral Sciences*, 2(2), 2137–2142. doi: 10.1016/j.sbspro.2010.03.295.

Millar, R. (2004). *The role of practical work in the teaching and learning of science*. University of York: Washington D.C.

Millar, R. (2012). Analysing Practical Science Activities to Assess and Improve their Effectiveness. *School Science Review*, 93(344), 136.

Millar, R. and Abrahams, I. (2009). Practical work :Research Database, The University of York. *School Science Review*, 91(334), 59-64. doi: 10.1007/978-3-319-07857-1_2.

Millar, R. (2011). Effective teaching in science. *Journal of Turkish Science Education*, 4(1), 20-44.

Ministry of Education and Culture. (1993). *Towards education for all*. Windhoek: Gamsberg Macmillan.

Ministry of Education and Culture. (2006). *Namibia Senior Secondary Certificate Biology syllabus*: *Higher level*. Okahandja: Namibia Institute of Educational Development (NIED).

Ministry of Education and Culture. (2010). *Namibia Senior Secondary Certificate Biology syllabus: Ordinary level.* Okahandja: Namibia Institute for Educational Development (NIED).

Ministry of Education and Culture. (2018). *Namibia Senior Secondary Certificate Biology syllabus: Ordinary level.* Okahandja: Namibia Institute for Educational Development (NIED).

Ministry of Education, Arts and Culture. (2016). Circular: DNEA/2018 NSSC Ordinary level Examination 2016-2017. Examiner's report. Windhoek, Ministry of Education.

Mutorwa, J. (2002). *Reflections on the implementation of Namibia's policy of moving toward education for all, with special emphasis on the goal of access: (1990-2000).* Published master's thesis. University of Montana.

Mwangu, E. C. and Sibanda, L. (2017). Teaching Biology Practical Lessons in Secondary Schools: A Case Study of Five Mzilikazi District Secondary Schools in Bulawayo Metropolitan Province, Zimbabwe. *Academic Journal of interdisciplinary studies*, 6(3), 47–55. doi: 10.1515/ajis-2017-0020.

Nacionales, E.N., Muyong, P.M. and Gavasan, J.C. (2015). The impact of motivation and learning strategies as predictors of Biology performance among non-science majors. *Asia Pacific Higher Education Research Journal*, 3(2), 1-9.

Namibia: The Constitution of the Republic of Namibia, 21 March 1990. http://www.refworld.org/docid/47175fd361.html

Nacionales, E. N., Muyong, P. M. and Gavasan, J. C. (2015). The Impact of Motivation and Learning Strategies as Predictors of Biology Performance among Non- Science Majors. *ASIA PAcIfIc HIgHer educAtIon reSeArcH JournAl*, 3(2), 14–22.

Nghipandulwa, L. L.T. (2012). Secondary school teachers' perceptions of practical work in biology in the Oshana education region. Unpublished master's thesis. University Of Namibia.

Ninnes, P. (2011). *Improving Quality and Equity in Education in Namibia : A trend and gap analysis.* Namibia: UNICEF.

Nwagbo, C. and Uzoamaka, C. (2008). Effects of Biology Practical Activities on Students' Process Skill Acquisition. Available online: http://stanonline.org/journal/df/JSTAN-chinwe&chukelu%2011.pdf

Ogembo, J. O., Otanga, H. and Yaki, N. R. (2015). Students' and Teachers' Attitude and Performance in Chemistry in Secondary Schools in Kwale County, Kenya. *Global Journal of Interdisciplinary Social Scienced*, 4(3), 39–43.

Oskamp, S. and Schultz, P.W. (2005). *Attitudes and opinions*. 3rd edition. New York: Prentice Hall.
Robert, G.B. (1989). *The ethics of educational research.* 1st edition. London: Routledge.

Roberts, R. (2004). Using different types of practical within a problem-solving model of science. *School Science Review*, 85(312), 113–120.

Rollnick, M. S. (1998). The influence of language on the second language teaching and learning of science. In W. W. Cobern (Ed.), *Socio-Cultural Perspectives on Science Education*: *An International Dialogue.* Dordrecht: Kluwer Academic Publishers.

Saddler, D. (1998). Formative Assessment: revisiting the territory. *Assessment in Education: Principles, Policy & Practice,* 5(1), 77-84.

Sakwa, T. (2017). Students and Teachers Perceptions of Physics Practical Work in Secondary Schools in Kakamega East Sub – County, Kenya. *International Journal of Innovative Research and Development*, 6(9), 260-265. doi: 10.24940/ijird/2017/v6/i9/aug17051.

Salant,P. and Dillman (1994). *How to conduct your own survey*. New York: John Wiley and Sons.

Sedumedi, T. D. T. (2017). Practical Work Activities as a Method of Assessing Learning in Chemistry Teaching. *Eurasia Jornal of Mathematics and Technology Education*, 13(6), 1765–1784. doi: 10.12973/eurasia.2017.00697a.

Sutton, C. (1998). New perspectives on language in science. In B. J. Fraser & K. G. Tobin (Ed.). *International Handbook of Science Education*. Great Britain: Kluwer Academic Publishers, 22-38.

Tamir,P. and Lunetta, V. (1981). Inquiry-Related Tasks in High School Science Laboratory Handbooks*. Science Education,* 65(5), 477-484.

Tokan, M. and Imakulata, M. (2019). The effect of motivation and learning behaviour on student achievement. *South African Journal of Education,* 39(1), 1–8.

Toplis, R. and Allen, M. (2012). "I do and I understand?" Practical work and laboratory use in United Kingdom schools. *Eurasia Journal of Mathematics, Science and Technology Education*, 8(1), 3–9. doi: 10.12973/eurasia.2012.812a.

Ualesi, Y. and Ward, G. (2018). Teacher's attitudes toward teaching science in a New Zealand Intermediate School. *Australian Journal of Teacher Education*, 43(6), 35-46.

Ufonabasi, E. and Nsimeneabasi, M. (2017). Effects of practical activities and manual on science students' academic performance on solubility in Uruan Local Education Authority of Akwa Ibom State. *Journal of education and Practice,* 8(3), 202-210.

Ulug, M., Ozden, M. S. and Eryilmaz, A. (2011). The effects of teachers' attitudes on students' personality and performance. *Procedia - Social and Behavioral Sciences*, 30, 738–742. doi: 10.1016/j.sbspro.2011.10.144.

Van Aalderen-Smeets, S. I., Walma van der Molen, J. H. and Asma, L. J. F. (2012). Primary teachers' attitudes toward science: A new theoretical framework. Science Education, 96(1), 158–182. https://doi.org/10.1002/sce.20467

Wheeler, G. F. (2000). *The three faces of inquiry. In J. Minstrell & E. H. van Zee Inquiry into learning and teaching in science.* New York: American Association for the Advancement of Science.

Wilfred, I.A. (2015). *Entrepreneurship Education and Training [online]*.Hong Kong: Intech Publishers.

Wilkinson, J. and Ward, M. (1997). A comparative study of students' and their teacher's perceptions of laboratory work in secondary schools. *Research in Science Education*, 27(4), 599–610. doi: 10.1007/BF02461483.

Willemse, M. and Deacon, E. (2015). *Experiencing a sense of calling : The influence of meaningful work on teachers ' work attitudes*. doi: 10.4102/sajip.v41i1.1274.

Winchester, C. L. and Salji, M. (2016). Writing a literature review. *Journal of Clinical Urology*, 9(5), 308–312. doi: 10.1177/2051415816650133.

Woolnough, B.E. (1994). *Effective Science Teaching: Developing Science and Technology Education*. Buckingmam: Open University Press.

Yara, P.O. (2009). Students' Attitude Towards Mathematics and Academic Achievement in some selected Secondary Schools in South Western Nigeria, *European Journal of Scientific Research*, 36(3), 336–341.

Yildiz, E., Akpinar, E., Aydogdu, B. and Ergin, O. (2006). Science teachers' attitudes towards aims of the science experiment. *Journal of Turkish Science Education,* 3(2), 2-18.

Zaidi, Z.F. (2010). Gender differences in human brain: A review. *The Open Anatomy Journal*, 2, 35-37.

Appendix

Appendix A

Study Instrument

Teacher questionnaire

Section 1

General questions

1. Gender _____
2. Highest qualification obtained_____
3. Subject level of teaching_____
4. Number of years teaching Biology_____
5. Age _____
6. Number of learners in a class_____

Section 2

In the following table of attitudinal items, tick in the box that best suits your opinion about practical work

Table 5.4-1 The Likert Scale

In each line, tick the box that most closely reflect your view	Strongly agree	agree	Neutral	Disagree	Strongly disagree
Often, when a practical activity needs more time than the time allocated to a period, I take extra time to conduct practical work.					
I love providing support to learners during practical work.					

I believe that teaching Biology is not fulfilled without practical work					
I enjoy collaborating with other teachers in preparing practical sessions					
I look forward to preparing practical work for learners.					
Doing practical work with learners motivates me as a teacher					
When I am engaging with learners in practical work, it gives meaning to being a Biology teacher					
It is fun showing learners how to do biological experiments					
When doing practical work with learners, I have confidence in demonstrating things to them					
I feel that practical examination should be a compulsory component of Biology examination					
I feel that practical work is the most important aspect of Biology subject					

Section 3

On a scale of 10, rank the following practical aims in order of importance

Pooled Order of Importance of Aims of Practical Work

Biology teachers

Grd 9 Grd 11

1 To encourage accurate observation and careful recording

2 To promote simple, common-sense, scientific methods

3 To develop manipulative skills

4 To give training in problem-solving skills

5 To fit the requirement of practical examination regulations

6 To be an integral part of the process of finding facts by Investigation

7 To elucidate the theoretical work so as to aid comprehension

8 To verify facts and principle already taught

9 To arouse and maintain interest in the subject

10 To make physical phenomena more real through actual experience

1. Why did you rank your first three items in that particular order?

_____
_____
_____
_____

2. Why did you rank the last three items as the least important?

_____
_____
_____
_____
_____
_____

3. What are your concerns about the aims of practical work?

_____
_____
_____
_____
_____

Appendix B

Institutional permission for research

UNIVERSITEIT STELLENBOSCH UNIVERSITY

APPROVED WITH STIPULATIONS
REC: Social, Behavioural and Education Research (SBER) - Initial Application Form

21 October 2019

Project number: CUR-2019-11283

Project title: Biology teachers' views and attitudes towards practical work in the Khomas region, Namibia.

Dear Ms Alina Shikongo

Your REC: Social, Behavioural and Education Research (SBER) - Initial Application Form submitted on 20 August 2019 was reviewed by the REC: Humanities and approved with stipulations.

Ethics approval period:

Protocol approval date (Humanities)	Protocol expiration date (Humanities)
21 October 2019	20 October 2022

PLEASE RESPOND TO THE FOLLOWING STIPULATIONS:

The researcher may proceed with the envisaged research provided that the following stipulations, relevant to the approval of the project are adhered to or addressed:

1) The researcher is reminded to supply the REC with proof of permission once obtained from the Ministry of Education Arts and Culture. The researcher may also require written permission from the school principal for access to her/his staff. The researcher should undertake to submit proof of such permission prior to commencing with recruitment and data collection [ACTION REQUIRED]

HOW TO RESPOND:

Some of these stipulations may require your response. Where a response is required, you must respond to the REC within three (3) months of the date of this letter. Your provisional approval will be withdrawn automatically should your response not be received by the REC within 3 months of the date of this letter.

For instructions on how to respond to these stipulations, please download the FAQ on how to edit your application and follow the steps carefully: HOW TO RESPOND TO REC FEEDBACK.

Where revision to supporting documents is required, please ensure that you replace all outdated documents on your application form with the revised versions.

Please take note of the General Investigator Responsibilities attached to this letter. You may commence with your research after complying fully with these guidelines.

If the researcher deviates in any way from the proposal approved by the REC: Humanities, the researcher must notify the REC of these changes.

Please use your SU project number (11283) on any documents or correspondence with the REC concerning your project.

Please note that the REC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

FOR CONTINUATION OF PROJECTS AFTER REC APPROVAL PERIOD

Please note that a progress report should be submitted to the Research Ethics Committee: Humanities before the approval period has

expired if a continuation of ethics approval is required. The Committee will then consider the continuation of the project for a further year (if necessary)

Included Documents:

Document Type	File Name	Date	Version
Research Protocol/Proposal	final proposal	14/08/2019	1
Informed Consent Form	Letter of consent (low risk)	14/08/2019	2
Data collection tool	instrument for the study	14/08/2019	1
Request for permission	letter to PS - Copy	15/08/2019	1

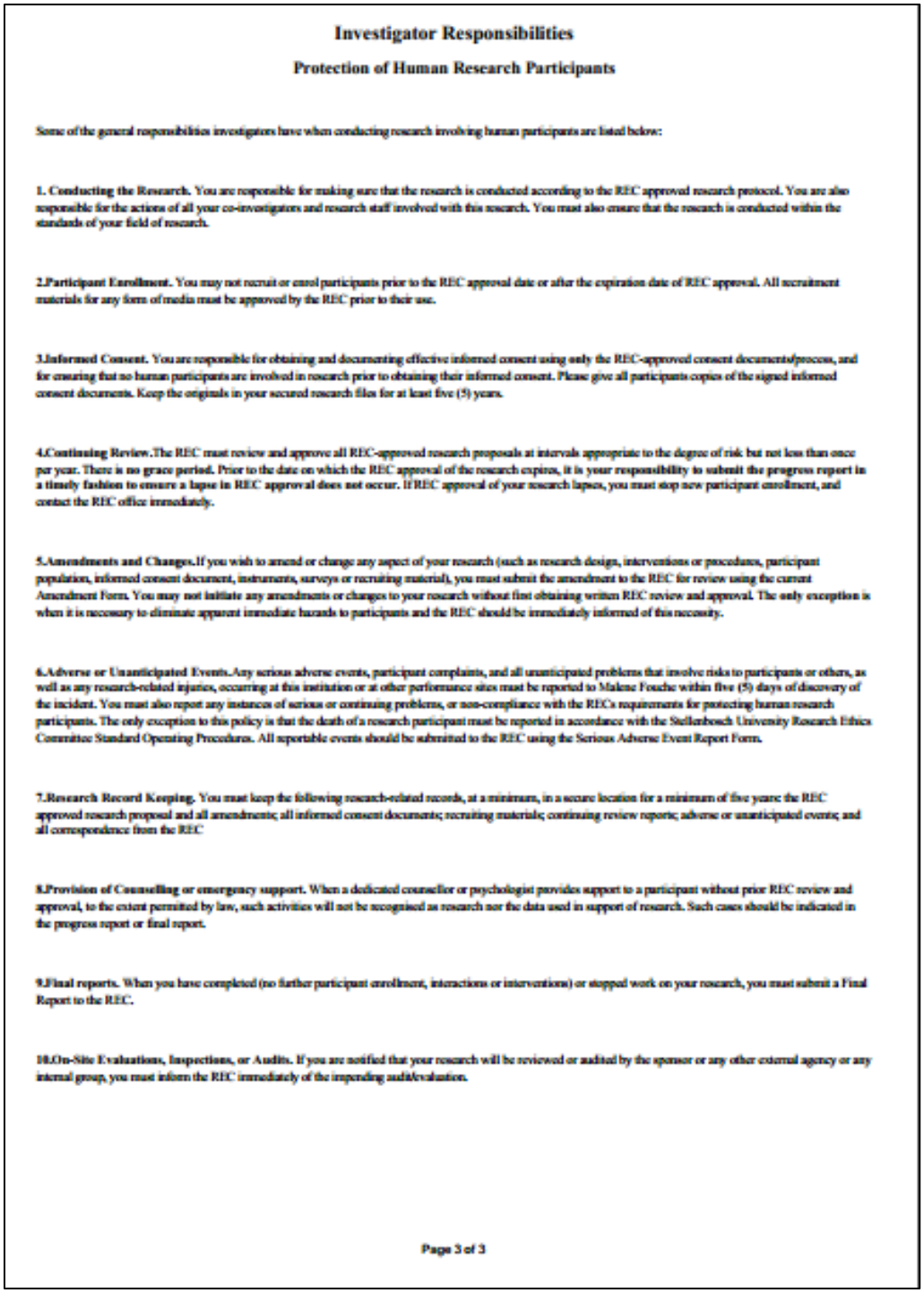
If you have any questions or need further help, please contact the REC office at cgraham@sun.ac.za.

Sincerely,

Clarissa Graham

REC Coordinator: Research Ethics Committee: Human Research (Humanities)

National Health Research Ethics Committee (NHREC) registration number: REC-050411-032.
The Research Ethics Committee: Humanities complies with the SA National Health Act No.61 2003 as it pertains to health research. In addition, this committee abides by the ethical norms and principles for research established by the Declaration of Helsinki (2013) and the Department of Health Guidelines for Ethical Research: Principles Structures and Processes (2nd Ed.) 2015. Annually a number of projects may be selected randomly for an external audit.



Investigator Responsibilities

Protection of Human Research Participants

Some of the general responsibilities investigators have when conducting research involving human participants are listed below:

1. **Conducting the Research.** You are responsible for making sure that the research is conducted according to the REC approved research protocol. You are also responsible for the actions of all your co-investigators and research staff involved with this research. You must also ensure that the research is conducted within the standards of your field of research.

2.**Participant Enrollment.** You may not recruit or enrol participants prior to the REC approval date or after the expiration date of REC approval. All recruitment materials for any form of media must be approved by the REC prior to their use.

3.**Informed Consent.** You are responsible for obtaining and documenting effective informed consent using only the REC-approved consent document/process, and for ensuring that no human participants are involved in research prior to obtaining their informed consent. Please give all participants copies of the signed informed consent documents. Keep the originals in your secured research files for at least five (5) years.

4.**Continuing Review.**The REC must review and approve all REC-approved research proposals at intervals appropriate to the degree of risk but not less than once per year. There is no grace period. Prior to the date on which the REC approval of the research expires, it is your responsibility to submit the progress report in a timely fashion to ensure a lapse in REC approval does not occur. If REC approval of your research lapses, you must stop new participant enrollment, and contact the REC office immediately.

5.**Amendments and Changes.**If you wish to amend or change any aspect of your research (such as research design, interventions or procedures, participant population, informed consent document, instruments, surveys or recruiting material), you must submit the amendment to the REC for review using the current Amendment Form. You may not initiate any amendments or changes to your research without first obtaining written REC review and approval. The only exception is when it is necessary to eliminate apparent immediate hazards to participants and the REC should be immediately informed of this necessity.

6.**Adverse or Unanticipated Events.**Any serious adverse events, participant complaints, and all unanticipated problems that involve risks to participants or others, as well as any research-related injuries, occurring at this institution or at other performance sites must be reported to Maléne Fouche within five (5) days of discovery of the incident. You must also report any instances of serious or continuing problems, or non-compliance with the RECs requirements for protecting human research participants. The only exception to this policy is that the death of a research participant must be reported in accordance with the Stellenbosch University Research Ethics Committee Standard Operating Procedures. All reportable events should be submitted to the REC using the Serious Adverse Event Report Form.

7.**Research Record Keeping.** You must keep the following research-related records, at a minimum, in a secure location for a minimum of five years: the REC approved research proposal and all amendments; all informed consent documents; recruiting materials; continuing review reports; adverse or unanticipated events; and all correspondence from the REC

8.**Provision of Counselling or emergency support.** When a dedicated counsellor or psychologist provides support to a participant without prior REC review and approval, to the extent permitted by law, such activities will not be recognised as research nor the data used in support of research. Such cases should be indicated in the progress report or final report.

9.**Final reports.** When you have completed (no further participant enrollment, interactions or interventions) or stopped work on your research, you must submit a Final Report to the REC.

10.**On-Site Evaluations, Inspections, or Audits.** If you are notified that your research will be reviewed or audited by the sponsor or any other external agency or any internal group, you must inform the REC immediately of the impending audit/evaluation.

Page 3 of 3

Figure B.1 Permission from University

Appendix C

Permission from the Ministry of Education, Arts and Culture

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

Tel: +264 61 -2933202
Fax: +264 61- 2933922
Enquiries: G. Munene
Email: Gibson.munene@moe.gov.na

Luther Street, Govt. Office Park
Private Bag 13186
Windhoek
Namibia

File no: 26/1/26

Ms Alina Shikongo
O. O. Box 1212
Oshakati

Email:alinashikongo@gmail.com

Dear Ms Shikongo,

SUBJECT: PERMISSION TO CONDUCT RESEARCH IN KHOMAS REGION

Kindly be informed that permission to conduct an academic research for your Master's Degree in Education in *"Biology Teachers' Views and Attitude Towards Practical Work in the Khomas Region in Namibia,"* is hereby granted. You are requested to present this letter of approval to the Regional Director to ensure that research ethics are adhered to and disruption of curriculum delivery is avoided.

Furthermore, we humbly request you to share your research findings with the Ministry. You may contact Mr G. Munene at the Directorate: Programmes and Quality Assurance (PQA) for submission of a summary of your research findings.

I wish you the best in conducting your research and I look forward to hearing from you upon completion of your study.

Sincerely yours

13.8.19

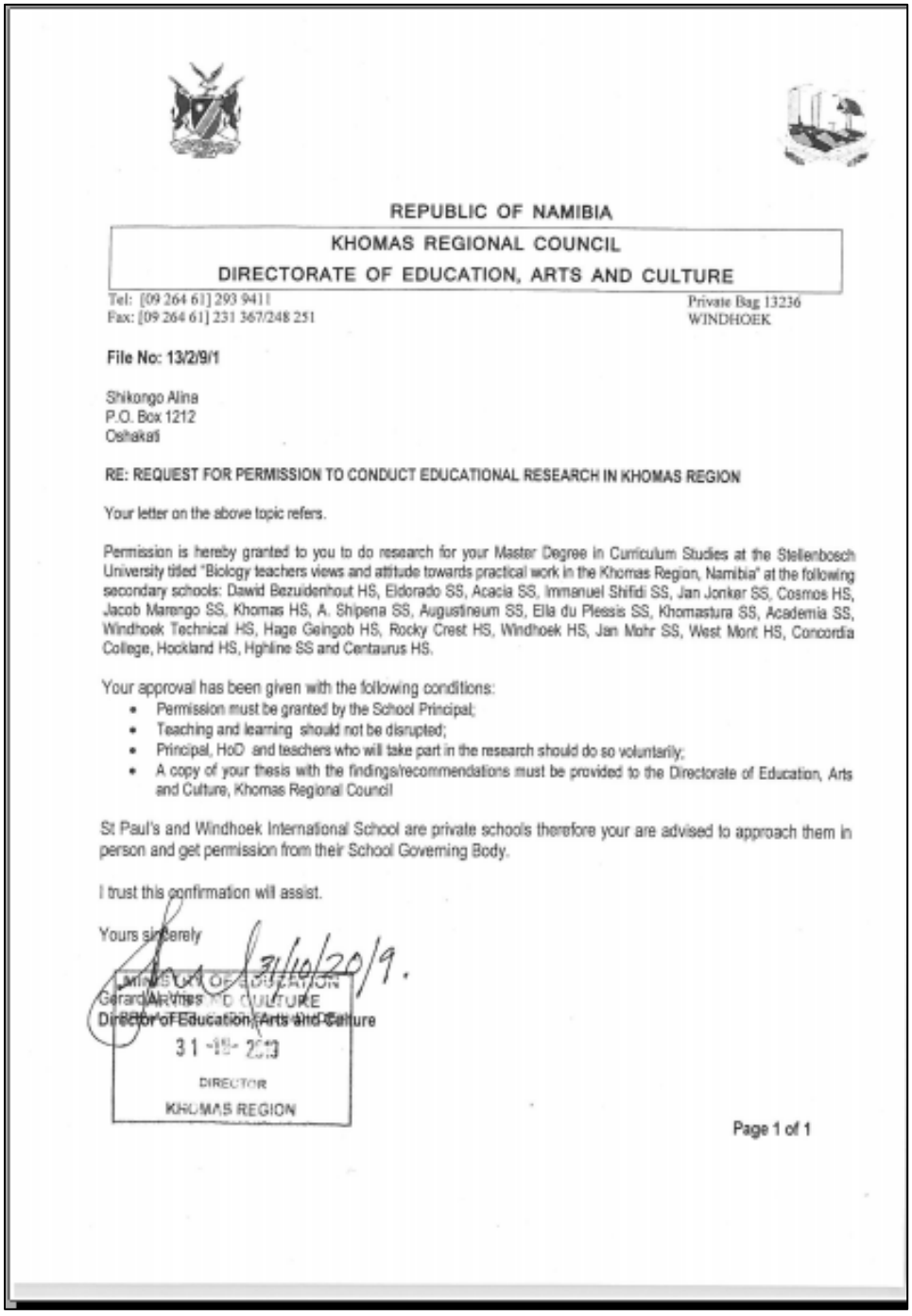
SANET L. STEENKAMP
EXECUTIVE DIRECTOR

All official correspondences must be addressed to the Executive Director.

Figure C.1 Permission from the Ministry of Education, Arts and Culture

Appendix D

Permission from the Khomas Regional Directorate of Education, Arts and Culture



REPUBLIC OF NAMIBIA

KHOMAS REGIONAL COUNCIL

DIRECTORATE OF EDUCATION, ARTS AND CULTURE

Tel: [09 264 61] 293 9411
Fax: [09 264 61] 231 367/248 251

Private Bag 13236
WINDHOEK

File No: 13/2/9/1

Shikongo Alina
P.O. Box 1212
Oshakati

RE: REQUEST FOR PERMISSION TO CONDUCT EDUCATIONAL RESEARCH IN KHOMAS REGION

Your letter on the above topic refers.

Permission is hereby granted to you to do research for your Master Degree in Curriculum Studies at the Stellenbosch University titled "Biology teachers views and attitude towards practical work in the Khomas Region, Namibia" at the following secondary schools: Dawid Bezuidenhout HS, Eldorado SS, Acacia SS, Immanuel Shifidi SS, Jan Jonker SS, Cosmos HS, Jacob Marengo SS, Khomas HS, A. Shipena SS, Augustineum SS, Ella du Plessis SS, Khomastura SS, Academia SS, Windhoek Technical HS, Hage Geingob HS, Rocky Crest HS, Windhoek HS, Jan Mohr SS, West Mont HS, Concordia College, Hockland HS, Highline SS and Centaurus HS.

Your approval has been given with the following conditions:

- Permission must be granted by the School Principal;
- Teaching and learning should not be disrupted;
- Principal, HoD and teachers who will take part in the research should do so voluntarily;
- A copy of your thesis with the findings/recommendations must be provided to the Directorate of Education, Arts and Culture, Khomas Regional Council

St Paul's and Windhoek International School are private schools therefore your are advised to approach them in person and get permission from their School Governing Body.

I trust this confirmation will assist.

Yours sincerely

31/10/2019.

Gerard Aarnes
Director of Education, Arts and Culture

MINISTRY OF EDUCATION, ARTS AND CULTURE
31 -10- 2019
DIRECTOR
KHOMAS REGION

Page 1 of 1

Figure D.1 Permission from the Khomas regional office

Appendix E

Permission from secondary schools in the Khomas region

GOREANGAB J.S.S.

P.O. Box 7109- Katutura- Windhoek- Tel: 261799 Fax: 215946

11 November 2019

Ms Alina N. Shikongo
P.O.Box 1212
Oshakati

Dear Sir

RE: Permission to conduct research and collect data at Goreangab J.S.S.

Your letter dated 11 November 2019 bears the following reference:

You are granted permission to conduct research at Goreangab J.S.S for your Masters Degree titled: The views and attitudes of Biology teachers towards practical work in the Khomas Region.

Please take note that you have to adhere to the conditions as set by the Khomas Regional Directorate of Education in the letter date 31 October 2019.

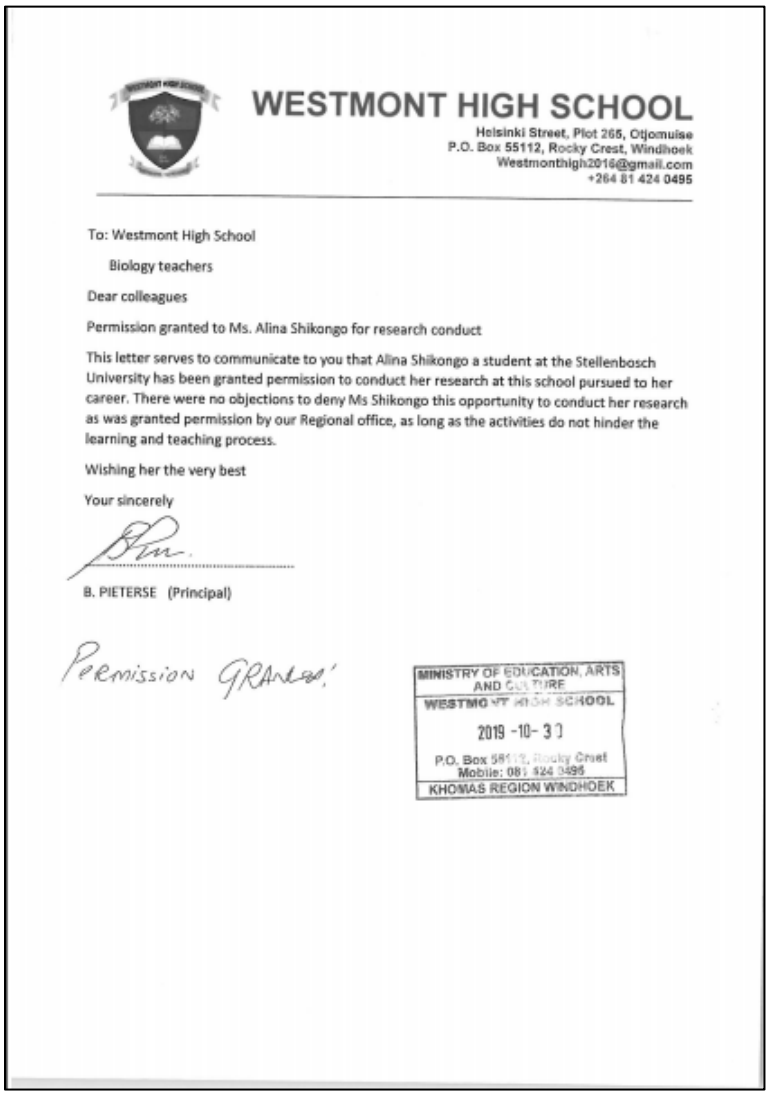
Goreangab J.S.S is wishing you all the best and hope that your research findings will be of great contribution to the body of knowledge.

Yours sincerely

Mrs. C. H. Nafuka
(PRINCIPAL)

MINISTRY OF EDUCATION
GOREANGAB JUNIOR SECONDARY SCHOOL
2019 -11- 11

Figure E.1 Permission from Goreangab JSS



WESTMONT HIGH SCHOOL

Helsinki Street, Plot 265, Otjomuise
P.O. Box 55112, Rocky Crest, Windhoek
Westmonthigh2016@gmail.com
+264 81 424 0495

To: Westmont High School

Biology teachers

Dear colleagues

Permission granted to Ms. Alina Shikongo for research conduct

This letter serves to communicate to you that Alina Shikongo a student at the Stellenbosch University has been granted permission to conduct her research at this school pursued to her career. There were no objections to deny Ms Shikongo this opportunity to conduct her research as was granted permission by our Regional office, as long as the activities do not hinder the learning and teaching process.

Wishing her the very best

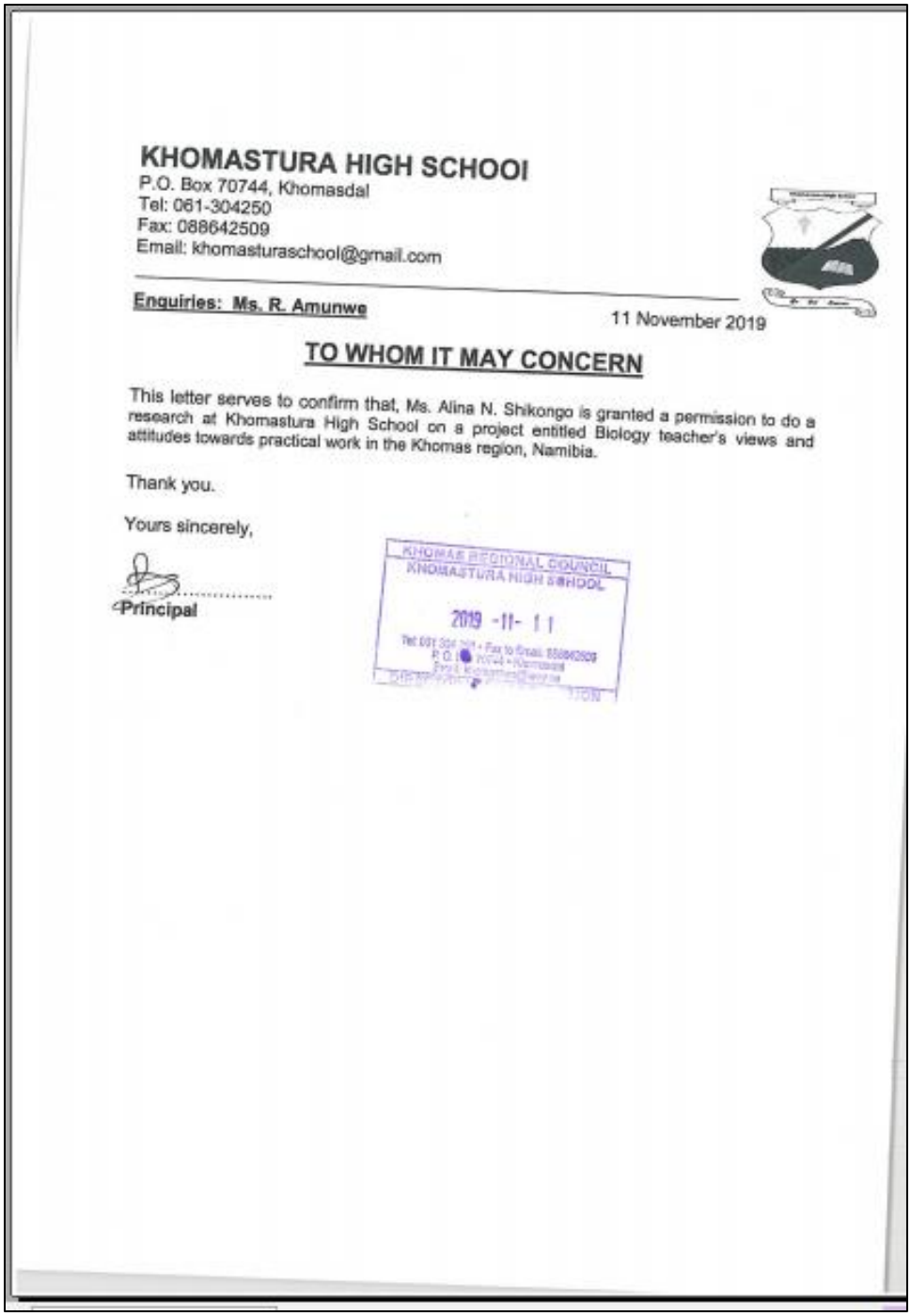
Your sincerely

B. PIETERSE (Principal)

Permission GRANTED

MINISTRY OF EDUCATION, ARTS AND CULTURE
WESTMONT HIGH SCHOOL
2019 -10- 30
P.O. Box 55112, Rocky Crest
Mobile: 081 424 0495
KHOMAS REGION WINDHOEK

Figure E.2 Permission from Westmond HS



KHOMASTURA HIGH SCHOOl
P.O. Box 70744, Khomasdal
Tel: 061-304250
Fax: 088642509
Email: khomasturaschool@gmail.com

Enquiries: Ms. R. Amunwe

11 November 2019

TO WHOM IT MAY CONCERN

This letter serves to confirm that, Ms. Alina N. Shikongo is granted a permission to do a research at Khomastura High School on a project entitled Biology teacher's views and attitudes towards practical work in the Khomas region, Namibia.

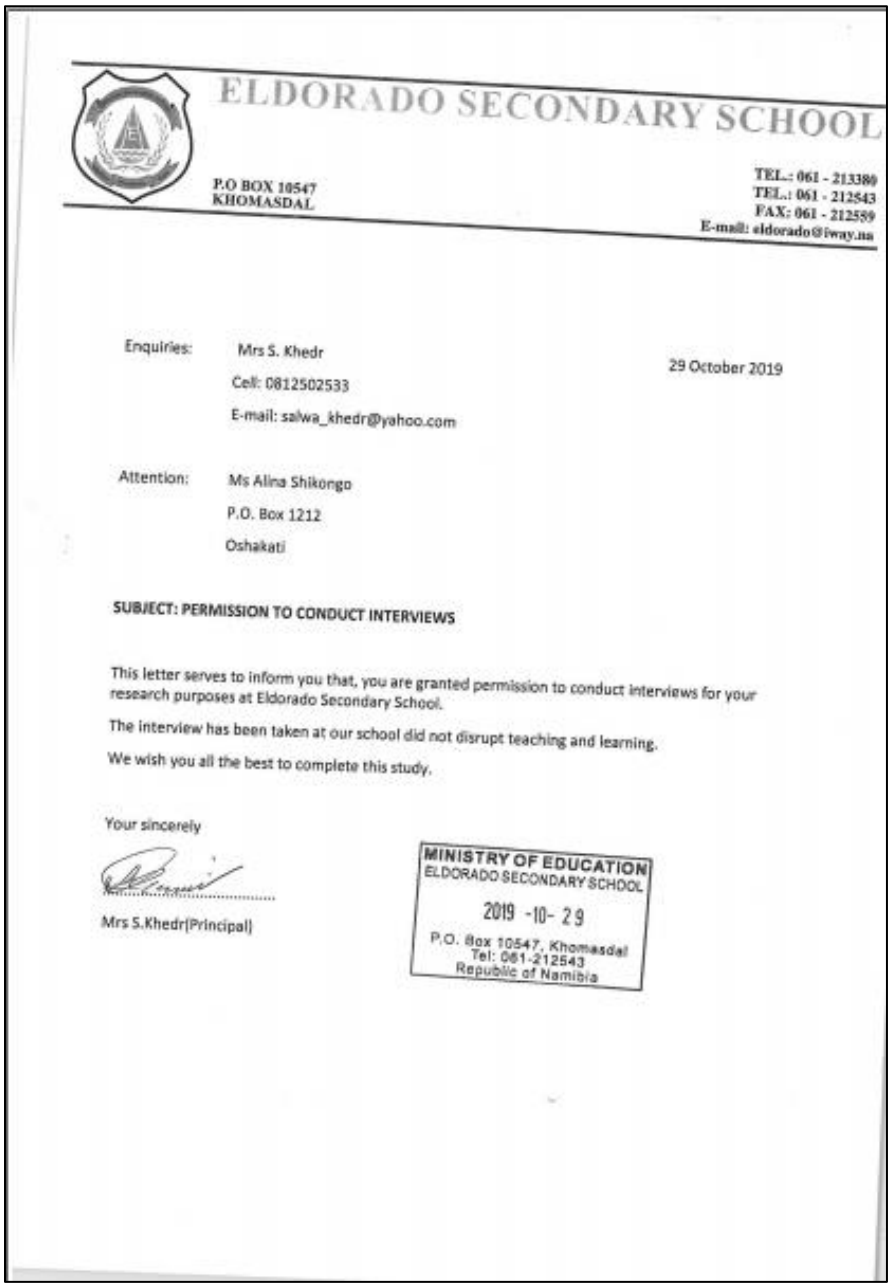
Thank you.

Yours sincerely,

.....
Principal

KHOMAS REGIONAL COUNCIL
KHOMASTURA HIGH SCHOOL
2019 -11- 11

Figure E.3 Permission from Khomastura HS



ELDORADO SECONDARY SCHOOL

P.O BOX 10547
KHOMASDAL

TEL.: 061 - 213380
TEL.: 061 - 212543
FAX: 061 - 212559
E-mail: eldorado@iway.na

Enquiries: Mrs S. Khedr
Cell: 0812502533
E-mail: salwa_khedr@yahoo.com

29 October 2019

Attention: Ms Alina Shikongo
P.O. Box 1212
Oshakati

SUBJECT: PERMISSION TO CONDUCT INTERVIEWS

This letter serves to inform you that, you are granted permission to conduct interviews for your research purposes at Eldorado Secondary School.

The interview has been taken at our school did not disrupt teaching and learning.

We wish you all the best to complete this study.

Your sincerely

.....

Mrs S.Khedr(Principal)

MINISTRY OF EDUCATION
ELDORADO SECONDARY SCHOOL
2019 -10- 29
P.O. Box 10547, Khomasdal
Tel: 061-212543
Republic of Namibia

Figure E.4 Permission from Eldorado SS

JAN MöHR SECONDARY SCHOOL

TEL: 061 - 237542
FAX: 061 - 237560

P O BOX 162
WINDHOEK

28 October 2019

Enquiries: Mr. L. Hashiti
Principal

Attention: Ms. Alina Shikongo
P.O. Box 1212
Oshakati

Dear Ms. Shikongo

Re: Request for permission to conduct research in Khomas Region

Permission is hereby granted to conduct an academic research for your Master's Degree in Education in "Biology Teacher' Views and Attitude Towards Work in the Khomas Region in Namibia.

Sincerely yours

L. HASHITI
(PRINCIPAL)

MINISTRY OF EDUCATION, ARTS AND CULTURE
WINDHOEK REGION
2019 -10- 29
JAN MÖHR SECONDARY SCHOOL
PO BOX 162 TEL: 237542
WINDHOEK FAX: 302543

Figure E.5 Permission from Jan More SS

IMMANUEL SHIFIDI SECONDARY SCHOOL

Enquiries: The Principal
Telephone: (061) 261153
Fax: (061) 263751

Private Bag 15001
KATUTURA
WINDHOEK

30 October 2019

Cell: 0811278964

TO WHOM IT MAY CONCERN

SUBJECT: PERMISSION TO COLLECT DATA FOR STUDY PURPOSE

This letter serves to inform your good Office that **Ms. ALINA SHIKONGO** has been granted permission to conduct interviews (collecting of data) at **Immanuel Shifidi Secondary School.**

The interviews (collecting of data) will not disrupt teaching and learning.

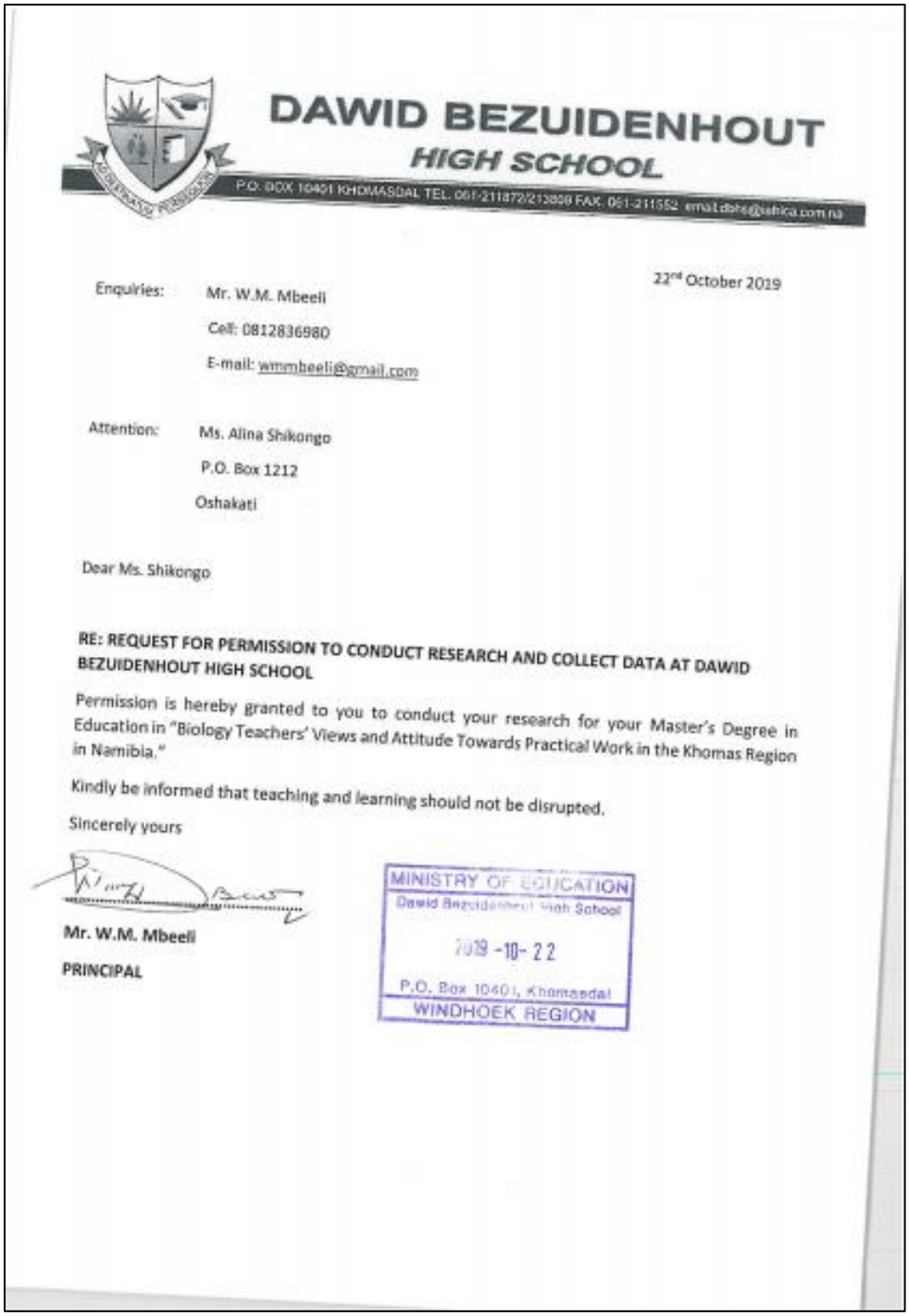
Thank you.

Yours faithfully.

MINISTRY OF EDUCATION, ARTS AND CULTURE
IMMANUEL SHIFIDI SECONDARY SCHOOL
-10- 19

MR. HNP KATJIUONGUA
PRINCIPAL

Figure E.6 Permission from Immanuel Shifidi SS



DAWID BEZUIDENHOUT
HIGH SCHOOL
P.O. BOX 10401 KHOMASDAL TEL: 061-211872/213808 FAX: 061-211552 email:dbhs@iafrica.com.na

Enquiries: Mr. W.M. Mbeeli
Cell: 0812836980
E-mail: wmmbeeli@gmail.com

22nd October 2019

Attention: Ms. Alina Shikongo
P.O. Box 1212
Oshakati

Dear Ms. Shikongo

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AND COLLECT DATA AT DAWID BEZUIDENHOUT HIGH SCHOOL

Permission is hereby granted to you to conduct your research for your Master's Degree in Education in "Biology Teachers' Views and Attitude Towards Practical Work in the Khomas Region in Namibia."

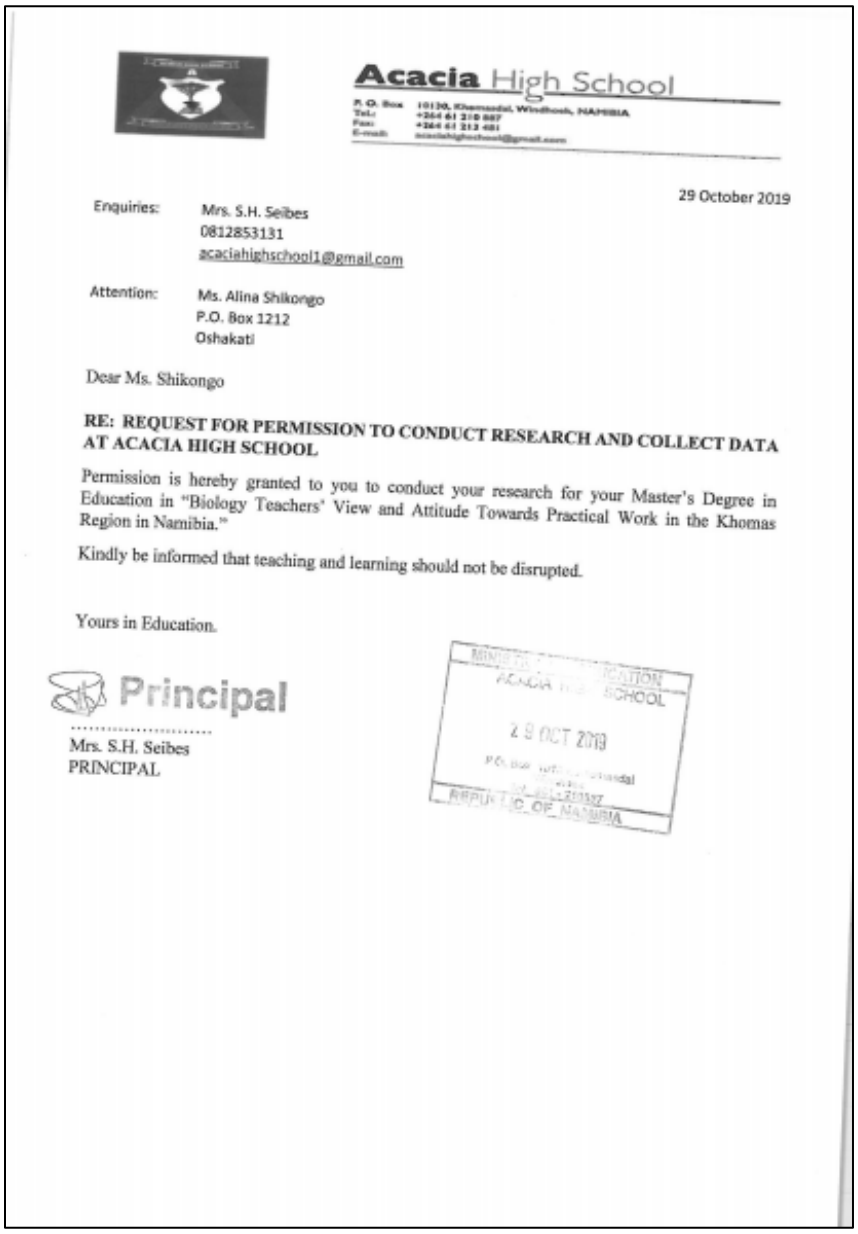
Kindly be informed that teaching and learning should not be disrupted.

Sincerely yours

Mr. W.M. Mbeeli
PRINCIPAL

MINISTRY OF EDUCATION
Dawid Bezuidenhout High School
2019 -10- 22
P.O. Box 10401, Khomasdal
WINDHOEK REGION

Figure E.7 Permission from Dawid Bezuidenhout HS



Acacia High School

P. O. Box 10130, Khomasdal, Windhoek, NAMIBIA
Tel.: +264 61 218 667
Fax: +264 61 213 481
E-mail: acaciahighschool@gmail.com

29 October 2019

Enquiries: Mrs. S.H. Seibes
0812853131
acaciahighschool1@gmail.com

Attention: Ms. Alina Shikongo
P.O. Box 1212
Oshakati

Dear Ms. Shikongo

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH AND COLLECT DATA AT ACACIA HIGH SCHOOL

Permission is hereby granted to you to conduct your research for your Master's Degree in Education in "Biology Teachers' View and Attitude Towards Practical Work in the Khomas Region in Namibia."

Kindly be informed that teaching and learning should not be disrupted.

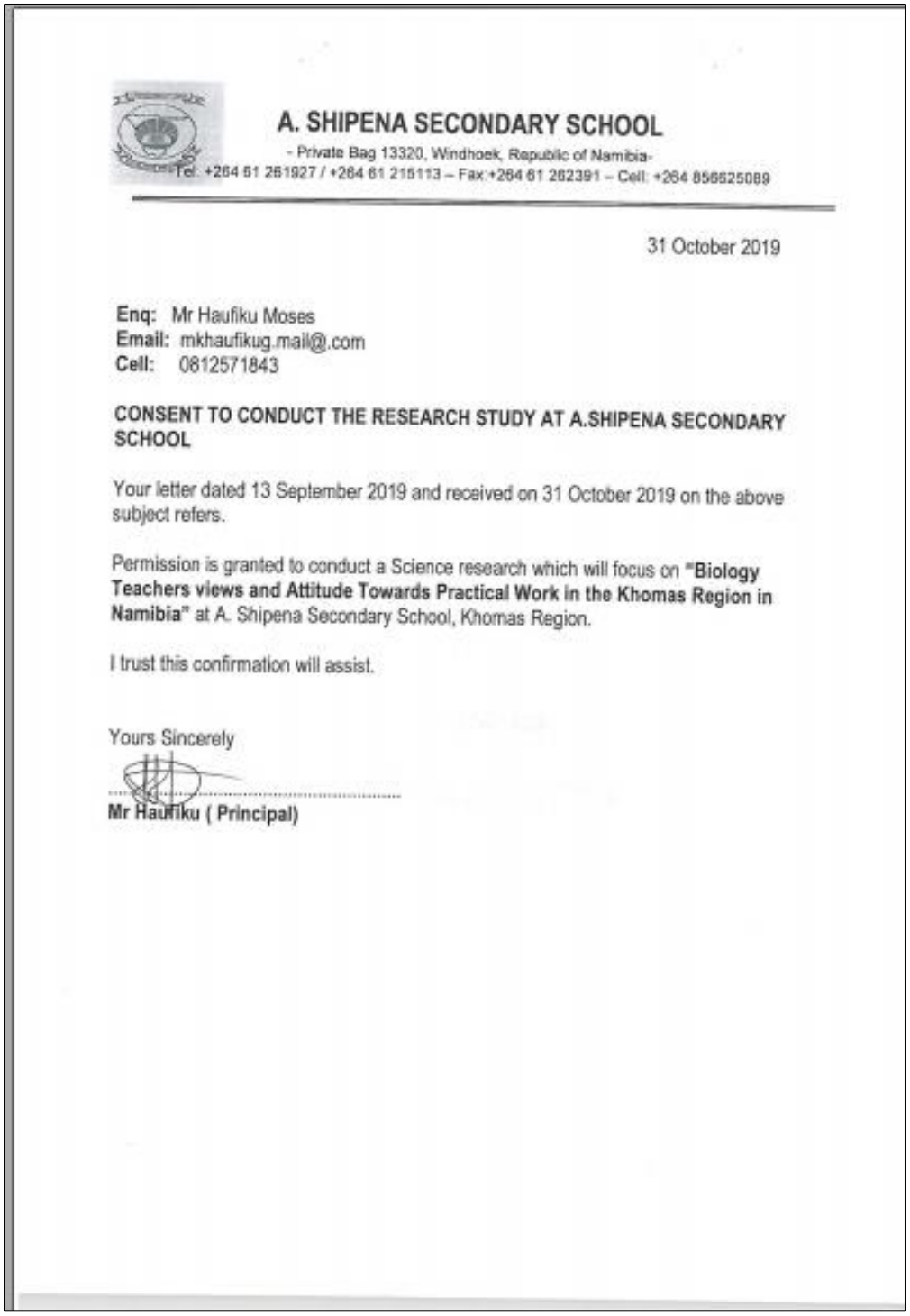
Yours in Education.

Principal

.....
Mrs. S.H. Seibes
PRINCIPAL

MINISTRY OF EDUCATION
ACACIA HIGH SCHOOL
29 OCT 2019
REPUBLIC OF NAMIBIA

Figure E.8 Permission from Acacia HS



A. SHIPENA SECONDARY SCHOOL

- Private Bag 13320, Windhoek, Republic of Namibia-

Tel: +264 61 261927 / +264 61 215113 – Fax:+264 61 262391 – Cell: +264 856525089

31 October 2019

Enq: Mr Haufiku Moses
Email: mkhaufikug.mail@.com
Cell: 0812571843

CONSENT TO CONDUCT THE RESEARCH STUDY AT A.SHIPENA SECONDARY SCHOOL

Your letter dated 13 September 2019 and received on 31 October 2019 on the above subject refers.

Permission is granted to conduct a Science research which will focus on **"Biology Teachers views and Attitude Towards Practical Work in the Khomas Region in Namibia"** at A. Shipena Secondary School, Khomas Region.

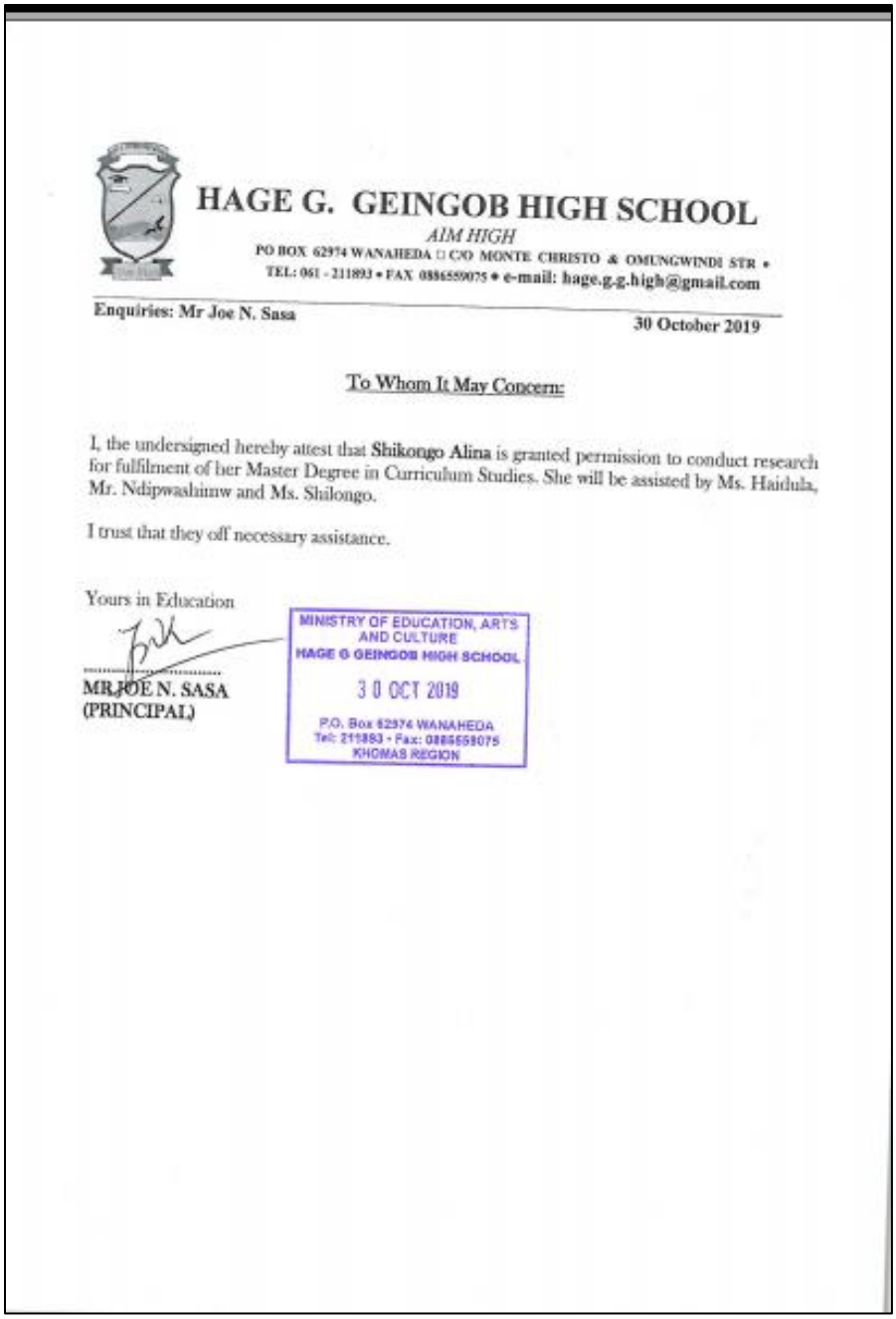
I trust this confirmation will assist.

Yours Sincerely

.....

Mr Haufiku (Principal)

Figure E.9 Permission from A.Shipena SS



HAGE G. GEINGOB HIGH SCHOOL

AIM HIGH

PO BOX 62974 WANAHEDA □ C/O MONTE CHRISTO & OMUNGWINDI STR •
TEL: 061 - 211893 • FAX 0886559075 • e-mail: hage.g.g.high@gmail.com

Enquiries: Mr Joe N. Sasa

30 October 2019

To Whom It May Concern:

I, the undersigned hereby attest that **Shikongo Alina** is granted permission to conduct research for fulfilment of her Master Degree in Curriculum Studies. She will be assisted by Ms. Haidula, Mr. Ndipwashinnw and Ms. Shilongo.

I trust that they off necessary assistance.

Yours in Education

MR JOE N. SASA
(PRINCIPAL)

MINISTRY OF EDUCATION, ARTS AND CULTURE
HAGE G GEINGOB HIGH SCHOOL
30 OCT 2019
P.O. Box 62974 WANAHEDA
Tel: 211893 - Fax: 0886559075
KHOMAS REGION

Figure E.10 Permission from Hage Geingob HS

JAKOB MARENGO SECONDARY SCHOOL

"EDUCATION FOR LIBERATION"

P. O. Box 1657, WINDHOEK
Email: nagirlch@iway.na

Tel: +264 61-262021
Fax: +264 61-263539

CONFIRMATION OF PERMISSION

The above mentioned school gave permission to **ALINA N. SHIKONGO** to do her research here.

The teachers Questionnaires were completed by two teachers.
Should you have any concerns about the above , please feel free to contact us.

Yours in Education

W.C. de Klerk (Principal)

MINISTRY OF BASIC EDUCATION, SPORT AND CULTURE
JAKOB MARENGO SEC.SCHOOL
04 NOV 2019
P.O. Box 1657 WINDHOEK
WINDHOEK REGION

Figure E.11 Permission from Jakob Marengo SS

AUGUSTINEUM SECONDARY SCHOOL

Florence Nightingale Street Private Bag 13227
Tel: (061) 211318/9 Windhoek
Fax: (061) 211536 Namibia

E-mail: augustineumss@gmail.com

Enquiries: Mr Matengu
0811244752

1 November, 2019

Ms Alina Shikongo
P.O.Box 1212
Oshakati

Dear Madam

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AND COLLECT DATA AT AUGUSTINEUM S.S.

Permission is hereby granted to you to conduct your research for your Master Degree in Education in 'Biology Teachers' views and Attitude towards Practical Working in the Khomas Region in Namibia.

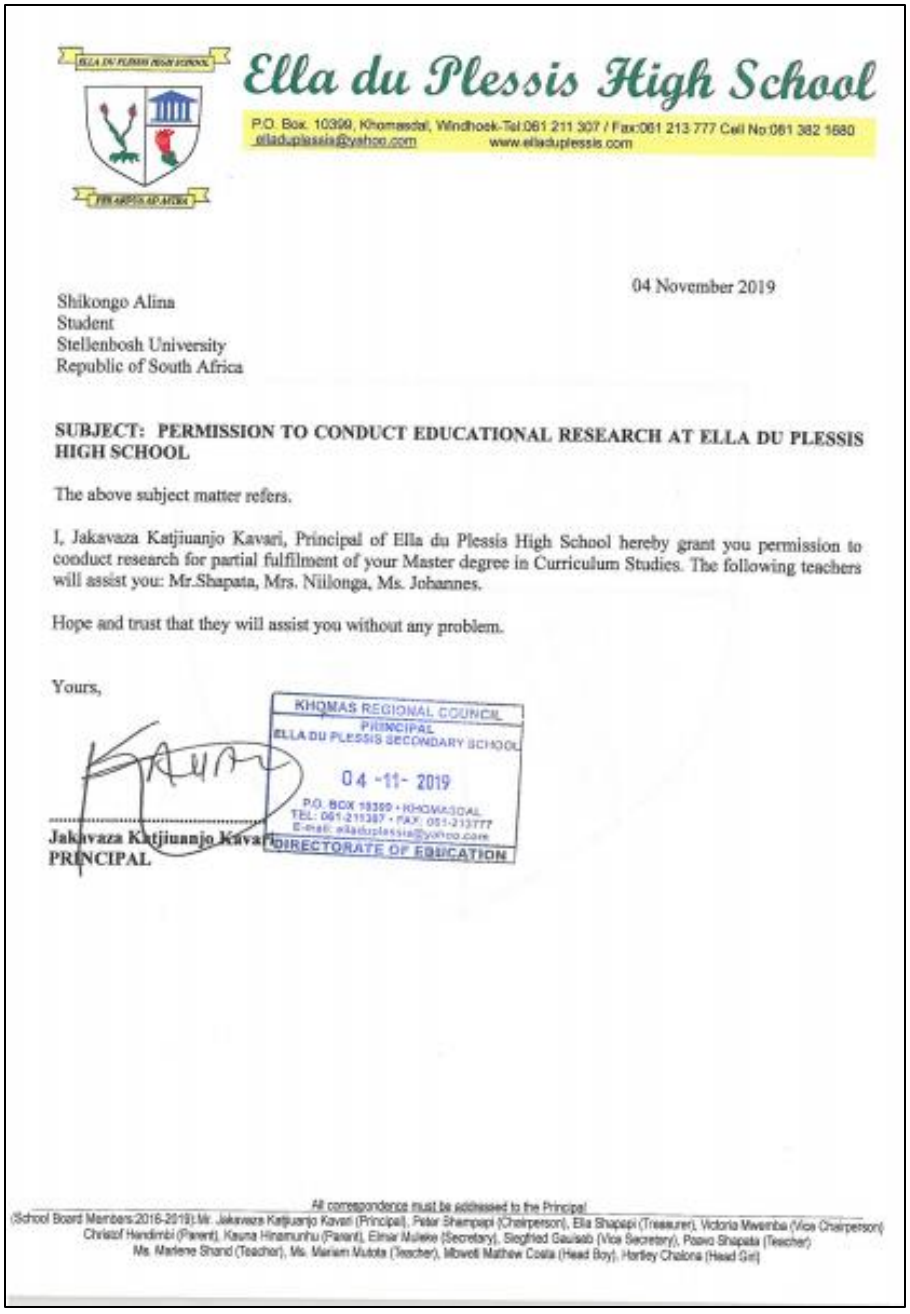
Kindly be informed that teaching and learning should not be disrupted.

Yours in Education

Mr R Matengu
PRINCIPAL

...Y OF EDUCATION
...USTINEUM S.S.
...OMAS REGION
01 NOV 2019
...-211 318/9
...-211 536
...WINDHOEK
...RETARY

Figure E.12 Permission from Augustineum SS



Ella du Plessis High School

P.O. Box 10399, Khomasdal, Windhoek-Tel:061 211 307 / Fax:061 213 777 Cell No:081 382 1680
elladuplessis@yahoo.com www.elladuplessis.com

04 November 2019

Shikongo Alina
Student
Stellenbosch University
Republic of South Africa

SUBJECT: PERMISSION TO CONDUCT EDUCATIONAL RESEARCH AT ELLA DU PLESSIS HIGH SCHOOL

The above subject matter refers.

I, Jakavaza Katjiuanjo Kavari, Principal of Ella du Plessis High School hereby grant you permission to conduct research for partial fulfilment of your Master degree in Curriculum Studies. The following teachers will assist you: Mr.Shapata, Mrs. Niilonga, Ms. Johannes.

Hope and trust that they will assist you without any problem.

Yours,

KHOMAS REGIONAL COUNCIL
PRINCIPAL
ELLA DU PLESSIS SECONDARY SCHOOL
04 -11- 2019
P.O. BOX 10399 • KHOMASDAL
TEL: 061-211307 • FAX: 061-213777
E-mail: elladuplessis@yahoo.com
DIRECTORATE OF EDUCATION

Jakavaza Katjiuanjo Kavari
PRINCIPAL

All correspondence must be addressed to the Principal

(School Board Members:2016-2019):Mr. Jakavaza Katjiuanjo Kavari (Principal), Peter Shampapi (Chairperson), Ella Shapapi (Treasurer), Victoria Mwemba (Vice Chairperson) Christof Handimbi (Parent), Kauna Hinamunhu (Parent), Elmar Mulieke (Secretary), Siegfried Gaubab (Vice Secretary), Paavo Shapata (Teacher) Ms. Marlene Shand (Teacher), Ms. Mariam Mutota (Teacher), Mbweti Mathew Costa (Head Boy), Hartley Chaiona (Head Girl)

Figure E.13 Permission from Ella Du Plessis SS

CONCORDIA COLLEGE

Private Bag 16002
Pioneerspark
WINDHOEK
Tel: +264 61 242 531
Fax: + 264 61 242 564
E-mail: concordiac@iway.na

12 November 2019

Dear Sir/Madam

TO WHOM IT MAY CONCERN

This is to testify and confirm that Ms. Alina Shikongo was here for her Master's Degree in Curriculum studies from University of Stellenbosch South Africa. To carry out research data collection process. Permission was granted to carry out her data collection on the topic titled "Biology teachers views and attitude towards practical work in the Khomas Region, Namibia.

We count on your prompt cooperation in this regard, and you may contact us for any further information.

MINISTRY OF EDUCATION
ARTS AND CULTURE
CONCORDIA COLLEGE
12 NOV 2019
P/Bag 16002-PIONEERSPARK
WINDHOEK REGION

Yours Sincerely

Acting School Principal

Mr. Philip Tawana

Cell-phone NO: 0812702296

Telephone at work: (+26461) 242531

Email Address: pnilinga@gmail.com

With One Heart

Figure E.14 Permission from Concordia College

Appendix F

Descriptive statistics by gender on importance options 1-10

Table 5.4-1 Gender on importance option 1

Importance option 1			
Factor	N	Mean	Std. Dev.
Total	41	6.15	3.66
Male	13	5.15	3.76
Female	28	6.61	3.59

Table 5.4-2 Gender on importance option 2

Importance option 2			
Factor	N	Mean	Std. Dev.
Total	41	5.63	2.7
Male	13	6.15	3.31
Female	28	5.39	2.39

Table 5.4-3 Gender on importance option 3

Importance option 3			
Factor	N	Mean	Std. Dev.
Total	41	5.8	2.99
Male	13	4.15	2.48
Female	28	6.57	2.92

Table 5.4-4 Gender on importance option 4

Importance option 4			
Factor	N	Mean	Std. Dev.
Total	41	5.46	2.62
Male	13	4.62	2.33
Female	28	5.86	2.69

Table 5.4-5 Gender on importance option 5

Importance option 5			
Factor	N	Mean	Std. Dev.
Total	41	5.41	2.84
Male	13	4.46	2.54
Female	28	5.86	2.9

Table 5.4-6 Gender on importance option 6

Importance option 6			
Factor	N	Mean	Std. Dev.
Total	41	4.8	2.69
Male	13	5.77	2.8
Female	28	4.36	2.56

Table 5.4-7 Gender on importance option 7

Importance option 7			
Factor	N	Mean	Std. Dev.
Total	40	4.83	2.36
Male	13	5.46	2.11
Female	27	4.52	2.46

Table 5.4-8 Gender on importance option 8

Importance option 8			
Factor	N	Mean	Std. Dev.
Total	40	4.9	2.69
Male	13	5.46	2.63
Female	27	4.63	2.72

Table 5.4-9 Gender on importance option 9

Importance option 9 Descriptive Statistics			
Factor	N	Mean	Std. Dev.
Total	38	5.71	2.79
Male	12	6.83	2.98
Female	26	5.19	2.59

Table 5.4-10 Gender on importance option 10

Importance option 10 Descriptive Statistics			
Factor	N	Mean	Std. Dev.
Total	38	6.24	3.12
Male	12	6.83	3.3
Female	26	5.96	3.07

Appendix G

Rankings for the ten importance options (HISTOGRAMS)

1. To encourage accurate observation and careful recording

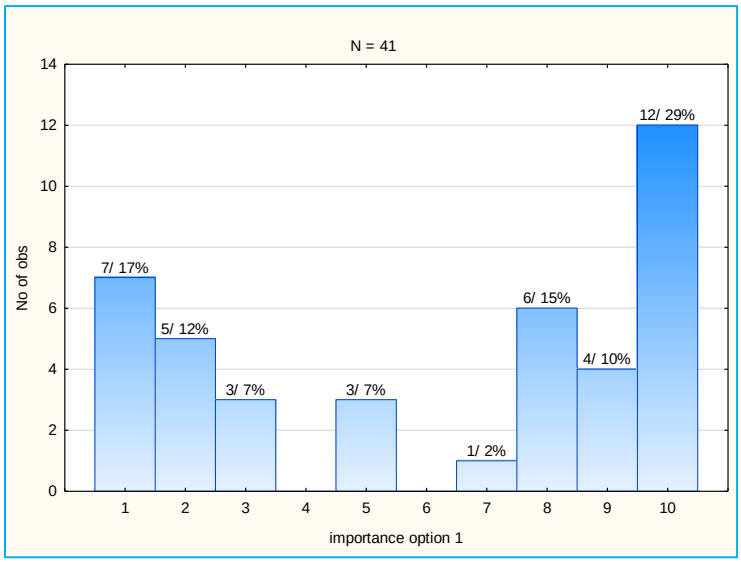


Figure G.1 Rankings of importance option 1

2. To promote simple, common-sense, scientific methods

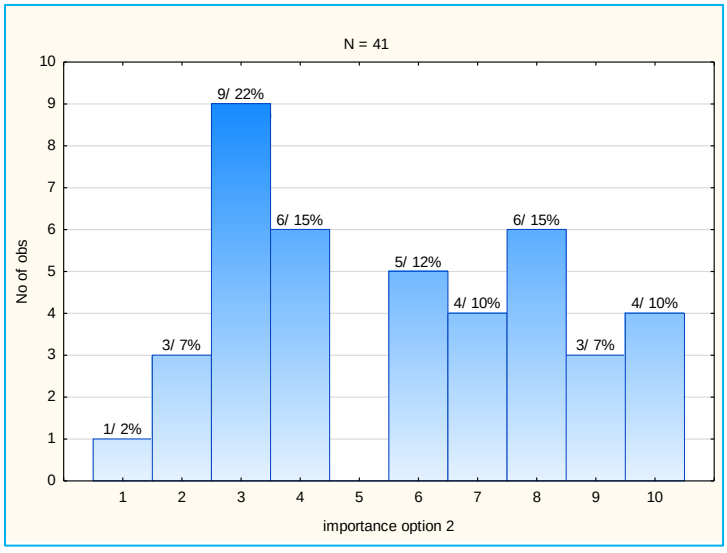


Figure G.2 Rankings of importance option 2

3. To develop manipulative skills

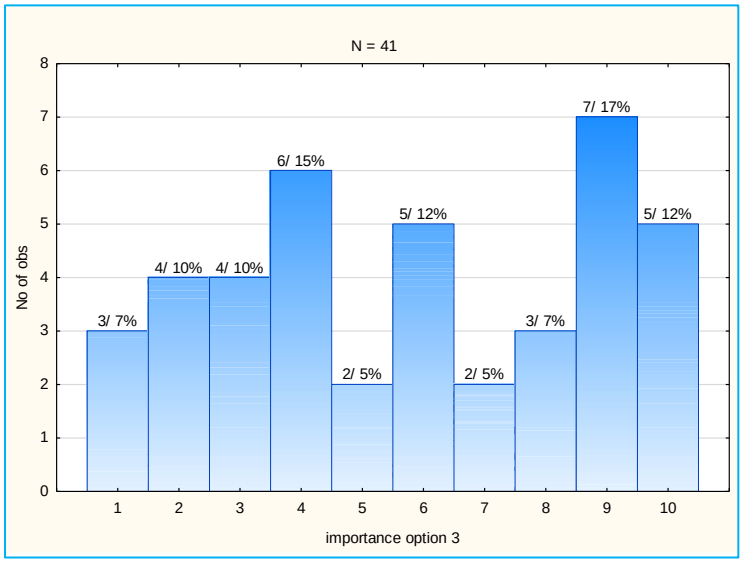


Figure G.3 Rankings of importance option 3

4. To give training in problem-solving skills

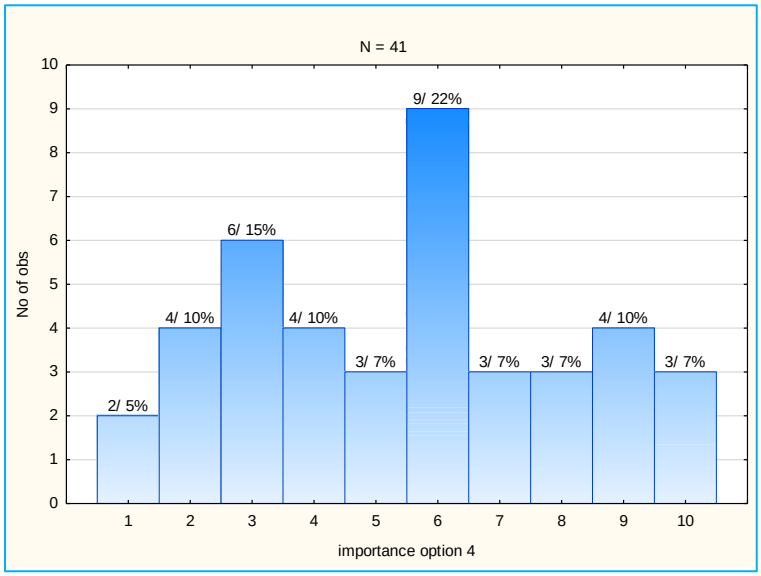


Figure G.4 Rankings of importance option 4

5. To fit the requirement of practical examination regulations

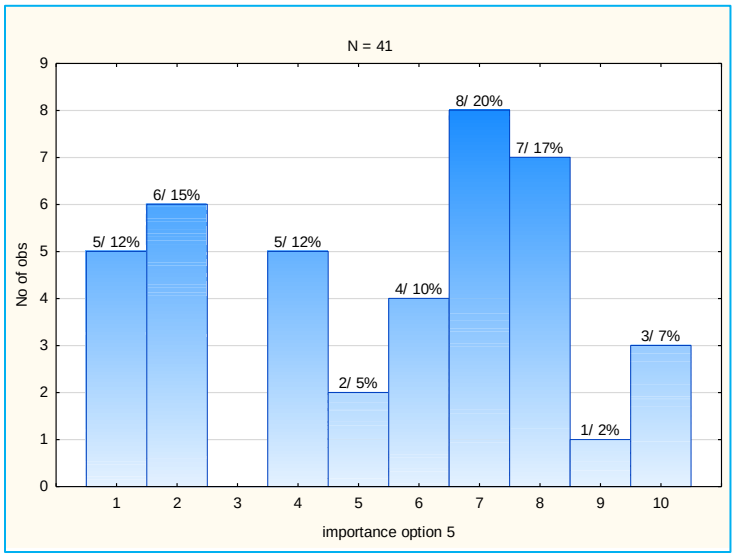


Figure G.5 Rankings on importance option 5

6. To be an integral part of the process of finding facts by investigation

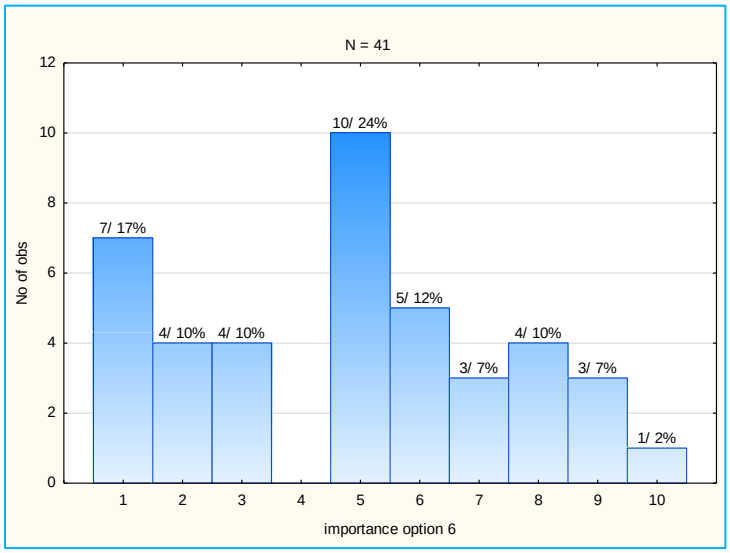


Figure G.6 Rankings on importance option 6

7. To elucidate the theoretical work so as to aid comprehension

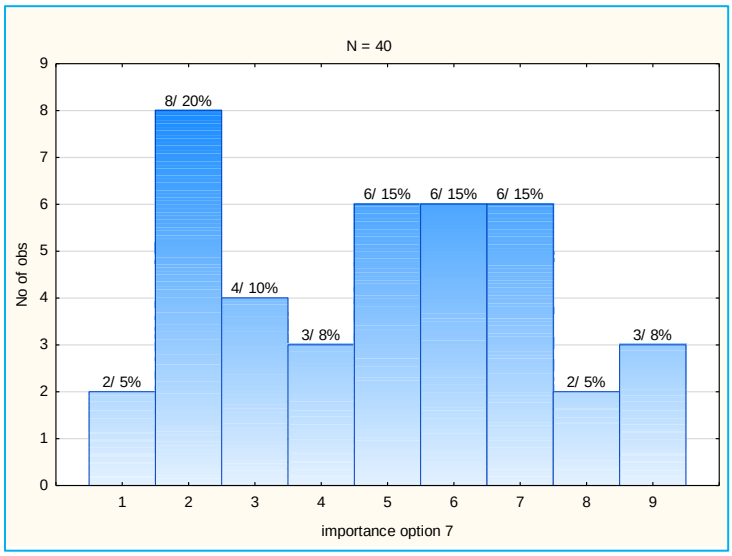


Figure G.7 Rankings of importance option 7

8. To verify facts and principle already taught

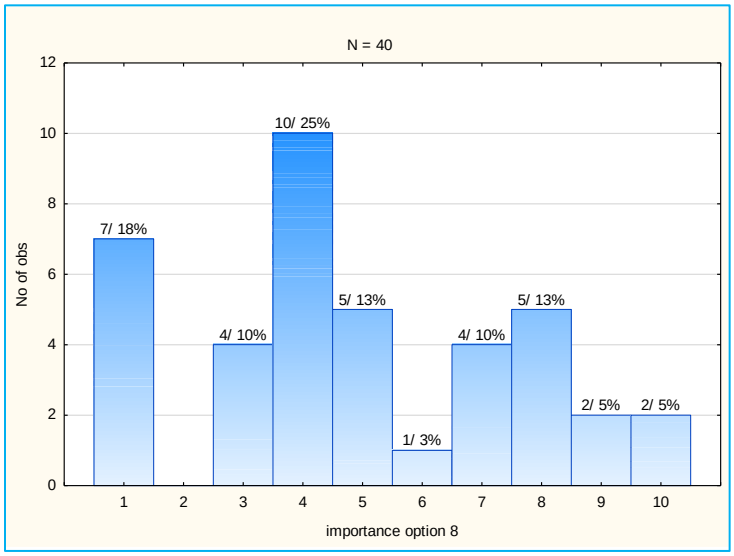


Figure G.8 Rankings of importance option 8

9. To arouse and maintain interest in the subject

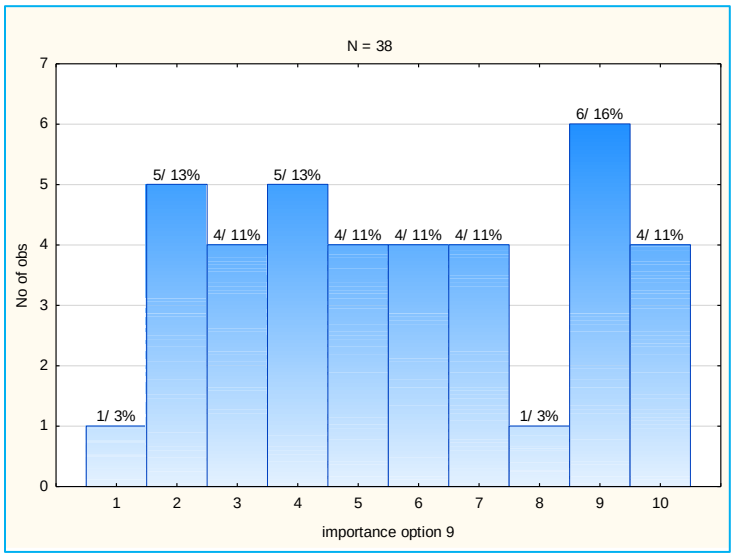


Figure G.9 Rankings of importance option 9

10. To make physical phenomena more real through actual experiment

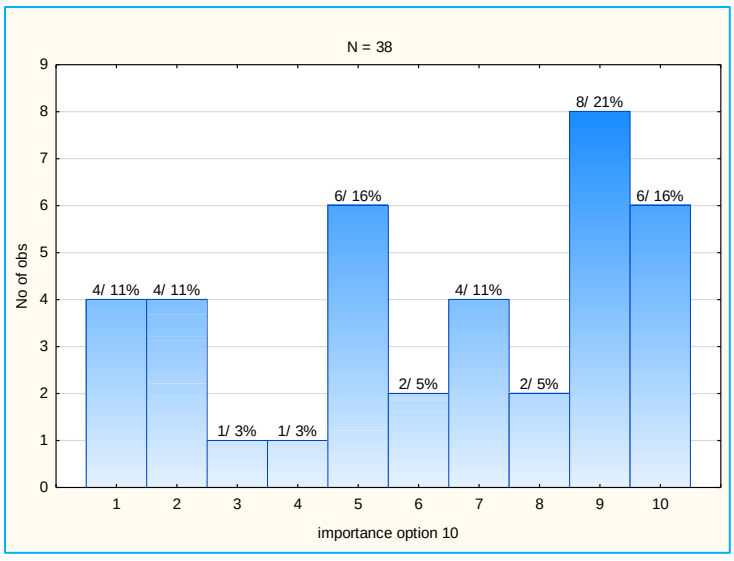


Figure G.10 Rankings of importance option 10

Appendix H

Descriptive statistics for ranking importance options

Table 5.4-11 Descriptive statistics on the importance options

Descriptive statistics			
Level of factor	**N**	**X Mean**	**X Std. Dev.**
Total	402	5.5	2.9
Item 10	38	6.2	3.1
Item 1	41	6.1	3.7
Item 3	41	5.8	3
Item 9	38	5.7	2.8
Item 2	41	5.6	2.7
Item 4	41	5.5	2.6
Item 5	41	5.4	2.8
Item 8	40	4.9	2.7
Item 7	40	4.8	2.4
Item 6	41	4.8	2.7